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MINERALS YEARBOOK



THE MINERAL INDUSTRIES OF

SOUTH ASIA

By David B. Doan, E. Chin, Gordon L. Kinney, and David Yen

1988

INTERNATIONAL REVIEW

U.S. DEPARTMENT OF THE INTERIOR

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SOUTH ASIA



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AFGHANISTAN¹

In 1980, Soviet troops were introduced into Afghanistan to back the National Government. However, civil disorder was pervasive throughout the country and rebel insurgents controlled rather substantial areas of Afghanistan. Civil disorder generally hampered industrial development and activity, severely limiting economic growth. With the pullout of Soviet troops completed in 1988, the country had undergone close to a decade of lost opportunities for many forms of foreign aid for development.

Afghanistan is a landlocked country flanked by the U.S.S.R., China, Pakistan, and Iran. Its major trading partner has been the Soviet Union and, to a very much smaller extent, member countries of the Council for Mutual Economic Assistance (CMEA). The most valuable item Afghanistan exports to the Soviet Union is natural gas. The two largest gasfields—Hodja-Gugerdag and Djar Kuduk—were in northern Afghanistan. Most of the output of the two fields was moved by twin 32-inch, 62-mile pipelines

to the U.S.S.R. Annual exports to the Soviet Union may have exceeded 78 billion cubic feet and may have been as much as 105 billion cubic feet. A 55-mile pipeline to the east to the industrial center at Maza-i-Sharif transported the natural gas for use at a 36,000-kilowatt electrical power station and a 105,000-ton-per-year urea fertilizer plant. However, transmission to the terminus was repeatedly disrupted by rebel action.

In addition to natural gas, Afghanistan exported all of its output of copper ore and concentrate from the Ainak Mine south of Kabul, most of the urea output at Maza-i-Sharif, and about 5% of the national output of cement to the U.S.S.R. Because Afghanistan's revenue is largely in rubles, the country was dependent on the Soviet Union for credits, materials, equipment, and technical assistance for industrial development. Furthermore, any new Kabul Government must continue to accept the Soviet Union as its major trading partner, or else must obtain a massive infusion of capital outlay from other sources to prevent economic collapse.

Coal deposits extend from Herat to Badakhshan in northern Afghanistan. The country's coal resources were estimated at 400 million tons, of which 100 million tons was considered proven reserves. Coal was mined at Karkar in Pul-e-Khumri, Ishpushta near Doshi, north of Kabul, and Dar-e-Suf, south of Mazar. CMEA countries were to deliver equipment for reconstruction of mines in the north, as well as to exploit new deposits to raise production in the area.

Soviet geologists working in Afghanistan mapped finds of many minerals. Large deposits of iron ore were found around the hills of Hajigak in Bamyan Province, about 100 kilometers (km) west of Kabul, and chromite was present in the Logar valley near Herat. Other minerals located and mapped by the Soviets included gold and silver in Panjshir; lapis lazuli in Badakhshan; asbestos, mica, and sulfur near Maimana; beryl in Junar; and barite in Bamyan. In addition, there were reportedly Soviet finds for bauxite, emerald, fluorspar, lead, lithium, tantalum, and zinc.²

TABLE 1
AFGHANISTAN: PRODUCTION OF MINERAL COMMODITIES^{1 2}

(Metric tons, unless otherwise specified)

Commodity	1984	1985	1986	1987 ^p	1988 ^a
Barite ^a	2,000	2,000	2,000	2,000	2,000
Cement, hydraulic ^a	112,000	77,000	95,000	100,000	100,000
Coal, bituminous ^a	148,000	151,000	160,000	150,000	150,000
Copper: Mine output, Cu content ^a	—	5,000	5,000	5,000	5,000
Gas, natural:					
Gross ^a million cubic feet	106,000	111,000	111,000	112,000	110,000
Marketed do.	95,859	100,655	100,840	^a 101,000	100,000
Gypsum ^a	3,000	3,000	3,000	3,000	3,000
Natural gas liquids ^a thousand 42-gallon barrels	81	93	81	80	80
Nitrogen: N content of ammonia ^a	³ 41,000	45,000	40,000	40,000	40,000
Salt, rock ^a	10,000	10,000	10,000	10,000	10,000

^a Estimated. ^p Preliminary.

¹ Table includes data available through Aug. 16, 1989.

² In addition to the commodities listed, asbestos, lapis lazuli, and a variety of crude construction materials (clays, stone, and sand and gravel) presumably were produced. However, output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

³ Reported figure.

BANGLADESH³

Bangladesh, whose population passed 110 million by yearend, remained one of the poorest countries in the world, with an estimated per capita gross domestic product (GDP) of \$168.⁴ Its only economically significant mineral production was natural gas. A few other minerals or mineral-based commodities were also produced, generally for local consumption. These included cement, clays, limestone, nitrogenous fertilizer, salt, and steel. Heavy mineral sands and crude oil were produced in token amounts but both have the potential to add significantly to the mineral sector's output. The Government planned to open 21 oil leaseholds, covering the entire country, to bidding from the international oil companies. A major promotion was slated for early 1989.

In response to multilateral and bilateral donor organization requests, the Bangladesh Government began planning an energy sector reorganization during 1988. A main feature is that the Bangladesh Oil, Gas and Minerals Corp. (BOGMC) is to become a holding company for five Government-owned natural gas exploration and marketing companies. A new exploration firm called Bangladesh Oil and Gas Exploration and Development Co. is to be formed also. BOGMC will be responsible for monitoring performance, planning, investment, and formulating policy in the oil and gas sectors. For the time being, at least, BOGMC and its subsidiaries will remain wholly owned by the Government.

In a related policy decision, the Government planned to increase the price of gas 15% and also the price of electricity by an unannounced amount. The changes will substantially reduce energy subsidies and improve the energy firms' financial performances.

In order to further exploit the natural gas resources, an Indian industry publication reported the Bangladesh Government has made an "attractive" offer to India to put up export-oriented ni-

trogen fertilizer plants in Bangladesh using Indian capital and domestic gas.⁵ India had been considering putting up plants in Persian Gulf countries until this offer was made.

Production of natural gas and nitrogenous fertilizer increased substantially during the fiscal year (FY) beginning in June 1987.⁶ Cement production was unchanged and clays, oil refinery output, salt, steel, and stone all declined a modest amount. Some of the declines were probably an indirect result of disruptions in the flow of raw materials because of widespread flooding. No direct damage by the flooding to mineral production facilities was reported. Railroads and highways were damaged in numerous places which may cause some longer term problems with distribution of the mineral and mineral-related commodities. A coal deposit at Barapukuria was being studied for possible development of the country's first commercial coal mine.

Mineral trade was modest and consisted mostly of imports of petroleum and coal in the energy sector, and cement and nonnitrogen fertilizers in the industrial minerals sector. Metal imports were mainly primary and semimanufactured forms of iron and nonferrous metals and metal-based machinery and transportation equipment.

Commodity Review

Industrial Minerals.—Fertilizer Materials.—A contract for the modernization and expansion of the Bangladesh Chemical Industry Corp.'s (BCIC) ammonia/urea plant in Ghorasal was awarded to Toyo Engineering Corp. of Japan. The plant, originally built by Toyo in 1970, will be improved by incorporating newly developed technology, which reduces energy consumption and increases output. Ammonia capacity is to increase from 218,000 tons per year to 272,000 tons per year and urea capacity from 375,000 tons per year to 467,000 tons per year. The revamping will cost \$88 million, some of which is

to be provided by Japan's Overseas Economic Cooperation Fund and the Japanese Government.

A turnkey contract has been awarded to Mitsubishi Heavy Industries Co. of Japan for the BCIC ammonia/urea plant in Jamuna. The long planned project had been delayed over financing arrangements. Production capacities are to be 1,078 tons per day of ammonia and 1,700 tons per day of urea. It is scheduled to cost \$300 million and come on-stream in 1991.⁷

The export-oriented Karnaphuli fertilizer plant was still awaiting final approval by the Bangladesh Government. Go-ahead on the construction was expected during 1989.

All of the country's fertilizer plants use domestic low-cost natural gas as feedstock and fuel.

The reported offer by the Government to invite Indian industry to build fertilizer plants in Bangladesh contains inherent advantages for both parties. The Government reportedly would offer complete flexibility in India's equity participation; gas, worker wages, and construction costs considerably below those of the Gulf countries; and a set of investment and tax incentives very favorable to foreign investment. There had been uncertainty as to whether India would be allowed a dominant position in shareholding and management of proposed projects in the Gulf countries. This was considered a key point in any Indian plans because pricing of the fertilizer produced had to be under India's control. An additional advantage of the Bangladesh offer would be a much lower freight cost to Paradip, which is the best Indian port for handling imports of ammonia and urea.

Mineral Sands.—Mineral sand deposits were discovered a number of years ago 100 km south of Chittagong in the Cox's Bazar region. Samples have been tested recently and a separation of the valuable components appeared to be feasible for commercial exploitation. The Govern-

ment has reportedly decided on a 5-year program to develop the deposits at a cost of \$7 million. The reserves, which occur both on the mainland beach and on the beaches of several nearby islands, are estimated at 5 million tons of ore.⁸

Mineral Fuels.—Coal.—Development of the Barapukuria coal deposit edged a step forward during the year. The British Overseas Development Administration had awarded a \$2.8 million grant to Wardell Armstrong Co. to conduct a high-resolution seismic survey and feasibility study for the development of a 0.5- to 1.0-million-ton-per-year mine. The coal was discovered in the Gondwana geologic formation extending over an area of 30 square km. The coal seam is reportedly 40 meters thick and the first discovered in Bangladesh in geologic conditions believed suitable for economic development.⁹

A 700-million-ton deposit of high-grade coal was discovered some years ago at Jamalganj during petroleum exploration drilling at a depth of 900 meters. Unfortunately, the depth and

geologic conditions at the site make economic development virtually impossible with current mining technology.

Natural Gas and Petroleum.—The expansion of the gas transmission and distribution system continued with help from a \$74 million Asian Development Bank concessional loan. Five new Districts north of Dhaka were to be serviced by 352 km of high-pressure pipeline. The 24-inch main line begins at Ashuganj and runs 117 km to Elenga on the east bank of the Jamuna River. Smaller feeder and distribution lines are to service a nitrogen fertilizer plant, a powerplant, and the towns and cities along the route.

At Haripur, a 100-megawatt (MW) gas turbine powerplant began operating in June, further increasing gas consumption and replacing expensive imported oil and coal. The plant was built with technical assistance from Mitsubishi Heavy Industries Ltd. and financial aid from the Overseas Economic Cooperation Fund of Japan.

The development of the natural gas

resources in Bangladesh has enabled the country to reduce its dependence on imported petroleum. Domestically produced gas now accounts for 57% of all commercial energy consumed in Bangladesh. With the emergence of gas as an alternative to oil, Bangladesh has reduced the amount of oil refined at its Chittagong Refinery from 36,000 to 22,000 barrels per day (bbl/d). The resultant saving of at least \$50 million in foreign exchange per year was an important favorable factor in an economy not characterized by many encouraging developments.

All told, 73 wells have been drilled within the country's present boundaries since 1910. The drilling resulted in discovery of 13 commercial gasfields, one of which, Kutubdia, was offshore. Estimated reserves vary considerably among sources but 13 trillion cubic feet is now being accepted as a realistic minimum in most circles. Additional drilling at the Haripur Gasfield resulted in the country's first crude oil production in 1987.

Notwithstanding its abundant gas re-

TABLE 2
BANGLADESH: PRODUCTION OF MINERAL COMMODITIES^{1 2}

(Metric tons unless otherwise specified)

Commodity	1984	1985	1986	1987	1988 ^P
Cement, hydraulic ³	272,619	240,176	*292,000	*310,000	359,812
Clays: Kaolin ³	2,613	4,178	2,695	12,272	10,097
Gas, natural, marketed ^{3 4} million cubic feet	80,257	90,958	101,138	118,955	151,646
Iron and steel: Metal ³					
Steel, crude (ingot only)	73,387	101,419	95,514	82,081	81,285
Steel products	100,741	126,582	111,593	129,986	121,865
Nitrogen: N content of ammonia and ammonium sulfate	352,888	358,480	390,515	435,900	673,400
Petroleum refinery products thousand 42-gallon barrels	7,958	7,357	7,405	*7,610	7,411
Salt, marine ³	671,832	489,000	*500,000	*416,000	409,000
Stone: Limestone, industrial ³	24,564	40,392	22,082	44,660	30,040

^P Estimated. ^P Preliminary.

¹ Table includes data available through Aug. 18, 1989.

² In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

³ Data are for years ending June 30 of that stated.

⁴ Gross production is not reported; the quantity vented, flared, or reinjected is believed to be negligible.

serves, the Bangladesh Government was determined to increase its exploration for commercial discoveries of crude oil. The Government planned to begin a promotional campaign aimed at finding coproduction partners for 21 oil leaseholds covering the entire country. The effort will involve seminars in Houston, United States; London, United Kingdom; and Dhaka, Bangladesh. Reportedly, a number of international firms have expressed interest. The Bangladesh press reported that traces of oil have been found at gas well sites at Bogra in western Bangladesh and at Kailashtilla in Sylhet. Testing of these discoveries was underway at year-end. Favorable findings at these sites would certainly add interest to the promotional program.

Shell Oil Corp. has ceased drilling in Bangladesh after investing nearly \$40 million since signing a production sharing contract with the Government in 1981. Its latest test in the Chittagong Hill Tracts failed to strike hydrocarbons to a depth of 1,450 meters.

INDIA ¹⁰

After several years of drought with increasingly serious consequences to India's economy, rains in 1988 ended the dry period and agricultural production rebounded. The entire economy was stimulated as hydroelectric power generation improved from increased volume of streamflow. Such power-intensive mineral industries as aluminum, copper, and steel benefited from a decrease in national or regional power outages. Meanwhile, they were increasingly installing their own on-site power-generating facilities. There was reason to believe that the real gross national product (GNP) grew by as much as 11% in FY 1988¹¹ compared with about 4.4% in 1987. Industrial production was up 9% overall and the services sector increased about 7%. Production of mineral commodities was generally greater than in 1987, with

one or two exceptions that were of secondary significance to the primary industrial needs of the economy.

Amidst this favorable performance, serious problems beset the country, including a large budget deficit, an increasing number of industrial insolvencies, a projected 300 million people living below the Government's stipulated poverty line, crippling power shortages, and a danger of increasing inflation.

The rupee depreciated by 14.8% against the dollar¹² in calendar year 1988 after a 2% gain the previous year. The rupee depreciated 11.6% against the British pound, 13.2% against the yen, and 4.5% against the deutsche mark. Although official opinion was that the rupee had adjusted downward to an optimum level against other currencies, it was not clear that the value of the rupee had stabilized. Moreover, the proportionate increase in GNP turned out to be a number fairly closely resembling the proportionate decrease in the value of the rupee in FY 1988. If in fact the economic expansion was being fueled by inflation, the consequences were not entirely unpredictable based on the experience of other countries.

The most difficult, and even dangerous, of the economic problems facing India over the longer term was the increasing inability to supply commercial power amidst rising industrial demand. India is economically sensitive to its rainfall, and for several years the yearly monsoon brought inadequate amounts. Consequences were severe to agriculture, stream and river discharge, and the generation of hydroelectric power. In 1988, the monsoon ended the drought by delivering heavy rains, stimulating the growing season, and providing the discharge to enable a significant increase of hydroelectric power generation. The replenishment of most of India's reservoirs assured an opportunity to close down some of the thermal generating plants for maintenance that had been deferred overly long. The fiscal year ended with a total electric power generation of 221 billion kilo-

watt hours versus a demand of 238 billion kilowatt hours,¹³ a much greater shortfall having been forestalled only by the favorable rains. Of the total power produced, a little less than 3% was generated at nuclear powerplants.

India's continual power shortages had multiple causes, chief among them delays in commissioning new power projects, lack of coordination between generators and distributors, chronic underpricing and undercollection, low utilization of capacity, widespread and continuing theft of electricity through illegal connections, and a rapid increase in domestic consumption. Not only did industry need increasing amounts of electricity, but so did the rapidly expanding middle class as well as the new office towers and hotels changing the appearance of many old cities.¹⁴ No clear indication was seen that this power shortage would end in the foreseeable future.

The per-capita consumption of commercial energy in India has been very low, approximating one-tenth of the global average. The physical quality-of-living index likewise put India in an extremely modest category, indicating great future demand for energy and growth of energy production. With a population of 817 million people increasing at least 2% annually, India was on the way to becoming the most populous country on earth in the next two or three decades. This eventuality has been accorded significance in projections involving the global environment.

Assuming India were to go through the same general cycle of energy production and development as did Europe and North America, with continued development of central power generation, the automobile, air conditioning, and a rapid increase in the use of electrical appliances, power production will need to undergo almost explosive development. Consequences to the world environment would depend upon the method of generation. With large reserves of mostly low-grade coal and lignite, India needed to consider moving rapidly to-

ward such technologies as fluidized-bed combustion to avoid atmospheric pollution in thermal power generation.

As of 1988, the future of exploration for petroleum hydrocarbons in India was not readily predictable. New exploration programs were launched, resulting in some discoveries, but it was too early to know if India had other resources similar to the prolific Bombay High that would enable the country to become a major producer. If so, some atmospheric pollution would be created by petroleum-based energy, but extra time could be bought in which to phase into a greatly expanded nuclear power program. If not, the rapidly expanding burden of power generation would fall on coal, with its relatively greater pollution, as demand became exacerbated.

India's nuclear generation of power achieved a record high of 6.068 billion kilowatt hours in 1988, an increase of 14% over the previous year and, it was hoped, a portent of things to come.¹⁵ In midyear, India's Atomic Energy Commission told the press it had approved sites for six new 500-MW, and two 235-MW nuclear powerplants. Additionally, two 1,000-MW nuclear plants were to be imported from the Soviet Union. All of the new plants were projected to become operational by the year 2000, by which time total nuclear-generating capacity was projected at 10,000 MW. The need for this new installed nuclear capacity was clearly critical; it would equal only slightly more than 4% of the total power demand of 1988.

Production

The most significant changes in production of mineral commodities in India for 1988 include alumina, up 83% over the previous year; gem-stone cutting and polishing, up 64%; metallic aluminum, up 42%; bauxite, up 36%; and copper blister, up 32%. Except for gem-stone processing, these were mainstream commodities having an impact on national development. Gem-stone cutting and polishing, however, was the

single largest foreign-exchange earner. Because it provided employment to a rapidly growing number of workers, more than 1 million, it contributed to the economy of India in a somewhat different way than the other commodities. Other important changes were chromite, up 21%; the fertilizer mineral urea, up 16%; ammonium nitrate, up 10%; and cement, up 10%.

In the mineral fuel sectors, coal production was up 6% and lignite up only 1%, despite the desperate need for increased energy. Petroleum crude production was up a bare 4%, with new discoveries both onshore and offshore offset by declining output from earlier wells. Natural gas production climbed 18%, the best achievement of the fuels sector in 1988.

Other noteworthy events included India's first-ever commercial production of a small quantity of metallic tin at the end of the year, by an industry that was expected to grow significantly. Moreover, the production of iron ore pellets was increased substantially according to early reports; the proportionate gain over previous years was not clear, as yet.

Two of the more significant negative changes in mineral commodity production were in mica, which was down 16% in the midst of nearly chaotic conditions of production, sale, and Government control; and diamonds, down 11% as expanding imports for cutting and polishing took some of the momentum out of exploration and mining.

All things considered, it was a good year for mineral production in India in spite of disappointment that greater increases were not realized for some mineral commodities, particularly in energy and steel. For example, the Visakhapatnam (Vizag) steel plant (VSP) was delayed yet another year, coal production did not come close to matching demand, and petroleum exploration and drilling seemed to be moving forward only very slowly.

India's labyrinthine bureaucratic process has not helped matters of mineral

production and development. An intricate system of proposals, counter proposals, approvals, disapprovals, policy changes, licensing, and regulation, all amidst private-sector venturing versus public sector sponsorship, generally exceeded anything the industrialized countries have experienced in their individual histories. For India to be able to succeed in producing more of any mineral commodity than in a previous year could only engender admiration for their dedication and entrepreneurship.

Trade

Although data were not yet available for a systematic inventory of India's international mineral-commodity trade for 1988, certain preliminary reports and observations were possible. India's declining rupee had the dual effect of increasing the competitiveness of exports and impairing its purchasing power for imports, thus the difficult matter of conserving foreign-exchange credits continued. Early indications were that exports could be expected to increase about 20% over that of 1987. Cut and polished gem stones, primarily diamonds, were the largest single item of export, earning approximately \$2.66 billion during the year and tightening India's hold on world leadership in this field.

The National Aluminium Co. (NALCO), commissioned in 1988, reportedly exported 384,000 tons of alumina, valued at more than \$100 million, to the United States, Norway, Brazil, North Korea, and China.

Exports of iron ore were burgeoning, Japan having agreed to buy 10 million tons during the year, Romania at least 3.5 million, the Republic of Korea 3 million; together with the commitments of other customers, projected exports were at least 17 million tons and, according to one unsubstantiated report, as much as 25 million tons, for 1988. However, concern was expressed that Japan considered some of its purchases of iron ore to grade only 54% to 60% iron versus the 64% iron content

TABLE 3
INDIA: PRODUCTION OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity ²	1984	1985	1986	1987	1988 ^P
METALS					
Aluminum:					
Bauxite, gross weight thousand tons	2,093	2,281	2,338	2,814	3,829
Alumina, gross weight do.	587	587	586	650	1,188
Metal, primary	268,520	260,010	257,096	265,000	375,000
Cadmium metal	148	194	160	214	237
Chromium: Chromite, gross weight	423,000	560,000	629,671	625,000	759,000
Copper:					
Mine output, Cu content	44,132	45,892	48,103	56,529	55,429
Metal, primary:					
Smelter	40,536	32,460	39,074	32,923	44,840
Refinery:					
Electrolytic (cathode)	32,580	28,020	37,853	*33,200	39,596
Fire refined ³	1,000	1,000	1,000	780	1,000
Total⁴	33,580	29,020	*38,853	30,587	40,596
Gold metal, smelter troy ounces	65,234	58,771	60,250	60,250	62,822
Iron and steel:					
Iron ore and concentrate:					
Gross weight thousand tons	41,026	42,545	47,800	51,018	52,322
Iron content do.	25,682	26,633	29,923	31,937	32,754
Metal:					
Pig iron do.	9,382	9,835	10,509	10,893	*10,000
Ferroalloys:					
Ferrochromium (including charge chrome)	³ 55,578	66,497	84,000	126,227	123,422
Ferromanganese	³ 121,829	163,438	179,132	172,819	137,689
Ferrosilicochromium	³ 3,892	12,499	*10,000	12,321	2,769
Ferrosilicon	³ 50,802	39,478	50,096	52,409	42,007
Other	³ 284	*500	*500	529	*500
Steel, crude:					
Steel ingots thousand tons	³ 10,261	10,962	11,332	12,605	*12,500
Steel castings do.	³ 84	92	95	278	340
Total do.	³10,345	11,054	11,427	12,883	*12,840
Semimanufactures ⁴ do.	³ 6,967	³ 7,841	7,753	8,600	9,200
Lead:					
Mine output, Pb content	24,839	27,085	37,578	*36,725	30,522
Metal, refined:					
Primary	15,246	15,567	19,933	20,669	18,833
Secondary	*10,000	*10,000	11,300	12,126	14,000
Total	³25,246	³25,567	31,233	32,795	32,833
Manganese:					
Ore and concentrate, gross weight thousand tons	1,130	1,240	1,213	1,302	1,324
Mn content	420,812	461,776	455,297	484,865	493,058

See footnotes at end of table.

TABLE 3—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1984	1985	1986	1987	1988 ³
METALS—Continued					
Rare-earth metals: Monazite concentrate, gross weight ⁴	4,000	4,000	4,000	4,000	4,000
Selenium kilograms	4,191	*4,850	*4,800	4,026	*4,100
Silver, mine and smelter output thousand troy ounces	862	816	1,134	1,220	1,429
Titanium concentrates, gross weight:					
Ilmenite	*140,000	³ 143,000	*140,000	*140,000	*38,000
Rutile	*6,000	³ 6,800	*7,000	*7,000	*5,000
Tungsten, mine output, W content	21	28	23	26	*30
Zinc:					
Mine output, concentrate:					
Gross weight	85,260	87,082	94,597	104,809	111,430
Zn content	44,335	45,283	49,198	54,500	57,944
Metal:					
Primary	55,753	70,947	72,000	68,899	68,940
Secondary ⁵	200	200	200	200	200
Total	55,953	71,147	*72,200	69,099	69,140
Zirconium concentrate: Zircon, gross weight	*12,000	14,800	*16,000	*16,000	*16,000
INDUSTRIAL MINERALS					
Abrasives, natural, n.e.s.:					
Corundum, natural	442	498	963	469	475
Garnet	*3,000	5,917	5,366	⁵ 6,699	4,099
Jasper	*5,000	5,078	2,426	4,407	3,782
Asbestos	25,450	30,183	25,236	29,110	31,303
Barite	446,000	579,742	344,000	247,000	393,000
Bromine, elemental ⁶	350	350	350	350	350
Cement, hydraulic thousand tons	29,030	33,050	³ 36,400	36,980	40,700
Chalk	*80,000	114,964	106,708	101,641	105,658
Clays:					
Ball clay	*135,000	236,625	277,460	279,912	308,144
Diaspore	*6,000	9,605	11,580	11,018	10,029
Fire clay	602,000	592,047	583,000	634,000	692,000
Kaolin:					
Direct salable, crude thousand tons	504	585	733	684	526
Processed do.	116	*110	*100	*150	*150
Total do.	620	*695	*833	*834	*676
Other ⁷ do.	80	100	100	100	100
Diamond:					
Gem ⁸ thousand carats	13	14	13	16	12
Industrial ⁹ do.	2	2	2	3	3
Total do.	15	16	16	19	15

See footnotes at end of table.

TABLE 3—Continued
INDIA: PRODUCTION OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity ²	1984	1985	1986	1987	1988 ^P
INDUSTRIAL MINERALS—Continued					
Feldspar	39,943	46,101	46,288	49,663	51,086
Fluorspar:					
Concentrates:					
Acid-grade	*12,000	11,107	*7,624	*8,261	*8,200
Metallurgical-grade*	5,000	5,000	4,109	4,448	4,500
Total	*17,000	*16,107	11,733	12,709	*12,700
Other fluorspar materials, graded	4,232	*4,000	6,841	5,790	4,387
Gem stones excluding diamond:					
Agate including chalcedony pebble	*1,000	750	*776	752	796
Garnet kilograms	*2,000	2,399	5,021	2,007	1,399
Graphite ⁶	38,986	27,337	38,412	42,589	52,134
Gypsum	1,378,000	1,260,369	1,549,000	1,861,000	1,576,000
Kyanite and related materials:					
Andalusite	2,700	504	732	122	—
Kyanite	37,024	30,472	32,394	39,959	36,951
Sillimanite	13,377	17,095	14,905	12,756	13,925
Lime*	500,000	500,000	600,000	700,000	750,000
Magnesite	414,029	417,412	422,000	430,000	460,000
Mica ⁷					
Exports:					
Block	1,100	1,200	1,200	1,000	1,000
Film and book for M cuttings	200	250	250	200	200
Splittings	3,000	4,000	4,000	3,000	3,000
Scrap	7,000	11,000	11,000	10,000	10,000
Powder	4,000	4,700	4,700	3,800	3,800
Manufactured ⁴	500	1,000	1,000	2,000	2,000
Total	15,800	22,150	22,150	20,000	20,000
Domestic use, all forms	3,000	3,500	3,500	4,000	4,000
Total mica	18,800	25,650	25,650	24,000	24,000
Nitrogen: N content of ammonia ³ thousand tons	3,832	4,270	4,933	5,300	6,205
Phosphate rock including apatite	892,000	929,098	667,070	679,419	678,000
Pigments, mineral, natural: Ocher	107,852	108,549	98,668	145,245	*145,000
Pyrites, gross weight	44,238	17,744	20,773	36,000	30,000
Salt:					
Rock salt thousand tons	5	4	2	1	4
Other do.	7,723	9,875	10,116	9,900	*9,200
Total do.	7,728	9,879	10,118	9,901	*9,202
Sodium carbonate	830,863	813,600	873,600	969,600	*980,000
Stone, sand and gravel: ⁸					
Calcite	*20,000	26,049	26,318	37,194	30,996
Dolomite thousand tons	2,277	2,217	2,139	2,233	2,213

See footnotes at end of table

TABLE 3—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	1984	1985	1986	1987	1988 ^c
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel—Continued					
Limestone thousand tons	45,483	48,070	52,562	57,170	61,054
Quartz and quartzite do.	*300	259	274	299	289
Sand:					
Calcareous do.	570	706	571	147	26
Other do.	*1,200	2,349	1,113	3,639	2,397
Slate	*5,000	5,529	6,483	6,637	6,216
Sulfur:					
Content of pyrites	17,695	7,098	8,309	14,400	12,000
Byproduct:					
From metallurgical plants*	115,000	120,000	120,000	120,000	125,000
From oil refineries	*5,000	305	*1,000	—	*1,000
Total*	137,695	127,403	129,309	134,400	138,000
Talc and related materials:					
Pyrophyllite	84,159	53,741	53,005	60,457	58,789
Steatite (soapstone)	333,576	329,192	343,000	371,000	382,000
Vermiculite	1,953	1,805	6,681	2,905	3,987
Wollastonite	*20,000	26,040	23,770	31,021	35,163
MINERAL FUELS AND RELATED MATERIALS					
Coal:					
Bituminous thousand tons	145,800	149,259	162,800	177,220	188,000
Lignite do.	7,500	7,774	7,900	8,311	8,400
Total do.	153,300	157,033	170,700	185,531	197,200
Coke:*					
Coke oven and beehive do.	12,000	13,000	13,000	13,000	13,000
Gashouse do.	100	100	100	100	100
Other, soft do.	50	100	200	200	200
Total do.	12,150	13,200	13,300	13,300	13,300
Gas, natural:					
Gross million cubic feet	255,700	287,200	*360,000	*350,000	*350,000
Marketable ⁹ do.	114,420	133,561	232,090	223,685	263,158
Petroleum:					
Crude thousand 42-gallon barrels	204,943	219,132	228,416	220,929	229,183
Refinery products:*					
Gasoline do.	26,000	34,000	42,000	49,000	50,500
Kerosene and jet fuel do.	27,000	38,000	45,000	50,000	51,500
Distillate fuel oil do.	84,000	95,000	110,000	116,000	119,500
Residual fuel oil do.	51,000	63,000	58,000	59,000	60,800
Lubricants do.	3,000	103,000	3,000	4,000	4,100

See footnotes at end of table.

TABLE 3—Continued
INDIA: PRODUCTION OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity ²	1984	1985	1986	1987	1988 ^P
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Other thousand 42-gallon barrels	42,000	50,000	55,000	56,000	57,700
Refinery fuel and losses do.	19,000	28,800	21,660	23,100	23,900
Total do.	252,000	305,800	334,660	357,000	366,000

^a Estimated. ^P Preliminary. ¹ Revised.

² Table includes data available through Sept. 20, 1989.

³ In addition to the commodities listed, other clays (bentonite, common clays, and fuller's earth), other gem stones (aquamarine, emerald, ruby, and spinel), and uranium are also produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels. In 1975, production of 6,514 metric tons of uranium ore containing about 3 metric tons of U₃O₈ was reported from two mines, which was only a part of total national production. Reported production of sand and gravel and stone are clearly only partial figures and exclude a number of types of stone; the amounts reported are inadequate to provide sufficient aggregate for production of concrete from domestically produced and consumed cement, nor do they provide for other supplies of aggregate for road metal and other construction uses.

⁴ Data are for fiscal year beginning Apr. 1 of that stated.

⁵ Excludes production from steel miniplants.

⁶ Official Indian Bureau of Mines figure is believed to be production from Government-owned operations. Private Indian production brings 1987 total to more than 20,000 tons.

⁷ India marketable production is 10% to 20% of mine production.

⁸ Data supplied here (exports plus domestic use) are provided in lieu of officially reported production because the latter figures are evidently incomplete. Officially reported production figures are as follows, in metric tons: 1984—7,171; 1985—6,965; 1986—4,684; 1987—4,299; and 1988—3,605.

⁹ Partial figures; for details, see footnote 2.

¹⁰ Includes reinjected gas.

¹¹ Reported figure.

declared by India's Minerals and Metals Trading Corp. (MMTC); Three shiploads of ore were sent back to India after reaching Japan. It was thought more would be heard on this subject. Exports of steel were reported to amount to 144,000 tons, 97,000 tons of it to the United States.

Other important exports in 1988 were chrome ore, thought to be at least three times the quantity exported in 1987 (the volume reached twice that of the previous year during the first 6 months of 1988); bauxite, possibly slightly more than was exported in 1987; manganese ore, evidently about the same as the quantity exported in 1987. Coal and mica exports, while significant, were down from those in 1987.

Imports of nonferrous metals were up in 1988, and the cost for copper, nickel, zinc, and other metals was reportedly expected to be 20% more than the \$665 million expended in 1987. Copper imports were projected to rise from 75,000 to 80,000 tons, zinc from

65,000 to 75,000 tons, and lead from 24,000 to 25,000 tons. Moreover, as much as 5,000 tons of nickel and an unspecified quantity of antimony were expected to be imported during the year. Although tin imports were up in the early part of 1988, India's new tin production, just started up, may have reduced the requirement for subsequent imports later in the year. Imports of aluminum, handled separately from the above metals as a result of decontrol, were difficult to project. Aluminum was previously imported at a cost of \$3,059 per ton by MMTC and resold domestically at \$2,015 per ton. Because the unsubsidized higher price was shifted directly to the consumers, some changes in buying patterns were anticipated.

Commodity Review

Metals.—Aluminum and Bauxite.—

Both bauxite and aluminum metal were produced in significantly greater quantities in 1988 than in 1987, despite

problems plaguing the industry.

At 3.011 million tons, bauxite production exceeded that of the previous year by 10% and penetrated the 3-million-ton mark for the first time. Metallic aluminum output was up a full 25% over that of the previous year to 334,500 tons.

Troubles abounded in the industry. Early in the year, NALCO, a new public-sector company in Orissa State at Angul, was forced to shut down 64 of 194 newly commissioned pots at its Orissa smelter after they went out of control, reportedly because of the inability of the potline workers to adapt to the rigorous operating schedules required by the new technology. This idle capacity was later restarted and the company began commissioning the remaining pots needed to bring the smelter up to the total of 240 pots. The changes were successful, and potrooms were able to produce 1.30 tons per pot per day versus a projected 1.26 tons per pot. Although output was thus reduced

SOUTH ASIA MINERALS YEARBOOK—1988

TABLE 4
INDIA: EXPORTS OF MINERAL COMMODITIES^{1 2}
(Metric tons unless otherwise specified)

Commodity	1984-85	1985-86	Destinations, 1985-86	
			United States	Other (principal)
METALS				
Aluminum:				
Ore and concentrate	61,547	36,436	—	United Arab Emirates 36,000; Bangladesh 436.
Oxides and hydroxides	49,474	40,967	—	U.S.S.R. 39,516; Japan 1,368.
Metal including alloys, all forms	5,598	13,509	115	U.S.S.R. 9,574; Iran 1,715; Bangladesh 1,147.
Cadmium: Metal including alloys, all forms	12	7	—	NA.
Chromium:				
Ore and concentrate	238,387	229,729	—	Japan 152,379; China 24,000; Bangladesh 18,500.
Metal including alloys, all forms	—	8,600	—	Japan 6,400; Italy 2,200.
Copper:				
Ore and concentrate	18,746	45,350	—	Republic of Korea 30,500; Taiwan 10,500.
Metal including alloys, all forms	1,325	1,729	129	U.S.S.R. 809; Taiwan 570.
Iron and steel:				
Iron ore and concentrate including roasted pyrite thousand tons	25,527	30,150	NA	Japan 20,249; Romania 3,334; Republic of Korea 2,972.
Metal:				
Scrap	52,449	64,182	NA	Philippines 46,534; Japan 17,625.
Pig iron, cast iron, related materials	1,466	221	139	Kenya 25; Canada 14.
Ferroalloys:				
Ferromanganese	1,950	5,330	NA	Japan 3,000; Qatar 2,320.
Ferrosilicon	—	10	—	All to Bangladesh.
Silicon metal	8	12	—	Bangladesh 6; North Korea 5.
Unspecified	42	180	NA	NA.
Steel, primary forms	197,103	95,122	39,372	China 14,920; Saudi Arabia 7,859; U.S.S.R. 6,091.
Lead: Metal including alloys, all forms	65	13	—	United Arab Emirates 8; Bangladesh 5.
Magnesium: Metal including alloys, all forms	—	2	NA	NA.
Manganese:				
Ore and concentrate, metallurgical-grade	621,432	486,380	—	Japan 259,978; Romania 142,614; Republic of Korea 67,288.
Oxides	204	33	—	Philippines 18; Bangladesh 14.
Metal including alloys, all forms	10	3	—	All to United Kingdom.
Nickel: Metal including alloys, all forms	76	14	—	Thailand 6; Czechoslovakia 4.
Selenium, elemental	15	—	—	—
Tin:				
Ore and concentrate	50	—	—	Nepal 48; Sudan 9; Sri Lanka 7.
Metal including alloys, all forms	607	73	—	United Kingdom 13,199; Japan 4,619.
Titanium: Ore and concentrate	7,852	17,956	—	Mainly to Bangladesh.
Tungsten: Metal including alloys, all forms	4	1	—	—

See footnotes at end of table.

TABLE 4—Continued
INDIA: EXPORTS OF MINERAL COMMODITIES^{1 2}
(Metric tons unless otherwise specified)

Commodity	1984-85	1985-86	Destinations, 1985-86	
			United States	Other (principal)
METALS—Continued				
Vanadium: Ore and concentrate ³	202	—		
Zinc: Metal including alloys, all forms	36	70	42	Sri Lanka 15; Bangladesh 6.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Natural: Corundum, emery, pumice, etc.	1,127	752	NA	NA.
Asbestos, crude	158	126	—	Czechoslovakia 46; West Germany 40; Bangladesh 20.
Barite and witherite	347,317	374,927	317,595	United Arab Emirates 24,673; U.S.S.R. 19,975.
Boron materials:				
Sodium borate	279	443	—	Sri Lanka 368; Singapore 32; Saudi Arabia 15.
Oxides and acids	34	21	—	Sri Lanka 14; Nepal 4.
Cement	21,543	47,659	NA	Nepal 11,466; unspecified 36,193.
Chalk	73	133	—	Bangladesh 131; Nepal 2.
Clays, crude:				
Bentonite	69,170	21,348	—	Kuwait 11,095; Sudan 2,966; Indonesia 2,500.
Fire clay	1,100	966	—	Bangladesh 856; Kenya 100.
Kaolin	5,307	8,329	NA	Bangladesh 6,762; Syria 800; Japan 700.
Unspecified	596	1,084	1	Bangladesh 1,021; Sudan 35.
Diamond: Gem, not set or strung value, thousands	\$955,236	\$1,126,606	\$556,487	Belgium-Luxembourg \$147,501; Japan \$144,920.
Feldspar	19,707	16,781	NA	Malaysia 8,638; Taiwan 2,084; Bangladesh 2,058.
Graphite, natural	1,876	1,045	249	Japan 215; Australia 148.
Gypsum and plaster	18,565	3,449	NA	Sri Lanka 3,137; Bangladesh 165; Oman 100.
Kyanite and related materials: Sillimanite	—	21	—	All to Bangladesh.
Magnesium compounds:				
Magnesite, crude	—	14	—	All to Australia.
Oxides and hydroxides	3,030	1,357	—	United Kingdom 899; Japan 417.
Mica:				
Crude including splittings and waste	16,430	18,107	3,963	France 3,238; Belgium-Luxembourg 3,106.
Worked including agglomerated splittings	13,125	15,779	951	West Germany 3,739; Japan 2,281; U.S.S.R. 2,156.
Phosphorus, elemental	4	102	44	Iraq 51; Republic of Korea 5.
Pigments, mineral:				
Natural, crude	360	860	—	Philippines 663; Bangladesh 57; Singapore 52.
Iron oxides and hydroxides, processed	5,190	3,619	54	United Kingdom 1,305; Philippines 601.

See footnotes at end of table.

TABLE 4—Continued
INDIA: EXPORTS OF MINERAL COMMODITIES^{1 2}
(Metric tons unless otherwise specified)

Commodity	1984-85	1985-86	Destinations, 1985-86		
			United States	Other (principal)	
INDUSTRIAL MINERALS—Continued					
Precious and semiprecious stones other than diamond: Natural:					
Emerald	value, thousands	\$2,940	\$1,608	\$972	Hong Kong \$132; Japan \$121.
Other	do.	\$12,454	\$21,955	\$10,010	Hong Kong \$2,441; West Germany \$1,824.
Salt and brine		29,684	15,915	NA	Bangladesh 6,100; Singapore 6,000; Nepal 3,730.
Sodium compounds, n.e.s.: Carbonate, manufactured		7	350	NA	NA.
Stone, sand and gravel:					
Dimension stone, all forms		489,155	371,607	2,357	Japan 184,021; Italy 82,019.
Dolomite, chiefly refractory-grade		2,142	7,786	NA	Bangladesh 7,203; Yemen, Aden 500.
Limestone other than dimension		187,255	230,488	NA	Bangladesh 225,798; Nepal 4,183.
Quartz and quartzite		53,784	70,775	NA	Japan 69,044; Bangladesh 1,621.
Sand other than metal-bearing		9,075	8,435	NA	Japan 5,207; United Arab Emirates 1,730.
Sulfur: Elemental: Crude including native and byproduct		22	1	—	All to Nepal.
Talc, steatite, soapstone, pyrophyllite		12,563	12,444	—	Netherlands 3,098; Kenya 2,324; Austria 2,000.
Vermiculite		465	1,044	—	Kuwait 567; United Arab Emirates 254; Taiwan 155.
MINERAL FUELS AND RELATED MATERIALS					
Coal, all grades including briquets	thousand tons	100	190	—	Bangladesh 92; Nepal 63; Republic of Korea 35.
Coke and semicoke		353	3,745	—	All to Nepal.
Petroleum:					
Crude	thousand 42-gallon barrels	48,203	3,929	NA	NA.
Refinery products: ⁴					
Light distillates:					
Naphtha	do.	5,202	15,266	NA	NA.
Other	do.	119	136	NA	NA.
Middle distillates	do.	985	970	NA	NA.
Heavy ends	do.	1,166	140	NA	NA.

¹ Revised. NA Not available.

² Table prepared by Audrey D. Wilkes.

³ Data are for Indian fiscal years Apr. 1 through Mar. 31 and have been compiled from the Indian Minerals Yearbook 1989.

⁴ May include other unspecified ores.

⁵ Defined as provided in data source.

TABLE 5
INDIA: IMPORTS OF MINERAL COMMODITIES^{1 2}
(Metric tons unless otherwise specified)

Commodity	1984-85	1985-86	Sources, 1985-86	
			United States	Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	971	368	32	West Germany 87; United Kingdom 81.
Metal including alloys, all forms	61,794	69,976	430	Bahrain 12,314; Brazil 10,352; Venezuela 10,347.
Antimony:				
Ore and concentrate	103	—	—	—
Metal including alloys, all forms	352	993	—	China 844; Taiwan 132.
Arsenic: Oxides and acids	5	—	—	—
Cadmium: Metal including alloys, all forms	20	64	—	All from Australia.
Chromium: Metal including alloys, all forms	73	28	—	United Kingdom 14; Japan 11.
Cobalt: Metal including alloys, all forms	116	134	3	Zambia 49; Zaire 39.
Copper:				
Ore and concentrate	—	88	—	NA.
Metal including alloys, all forms	80,138	142,377	6,103	Zambia 54,684; Zaire 16,909; Singapore 9,201.
Iron and steel: Metal:				
Scrap	618,646	1,331,719	663,438	Netherlands 250,144; West Germany 179,570.
Pig iron, cast iron, related materials	3,546	21,360	NA	Pakistan 8,655; Japan 7,200; Brazil 4,900.
Ferroalloys:				
Ferrochromium	9,172	11,390	—	Sweden 4,847; West Germany 3,049; Japan 2,077.
Ferromanganese	811	962	—	West Germany 312; Netherlands 233; Japan 148.
Ferromolybdenum	10	2	—	All from Austria.
Ferronickel	19,036	23,324	705	France 6,803; Colombia 4,339; New Caledonia 3,236.
Ferrosilicochromium	5	—	—	—
Ferrosilicon	129	300	—	United Kingdom 84; Japan 72; Netherlands 65.
Silicon metal	1,387	2,152	28	Norway 652; France 434; Canada 217.
Unspecified	1,027	1,430	NA	NA.
Steel, primary forms	1,842,312	2,302,074	33,449	West Germany 604,172; Japan 592,468.
Lead:				
Ore and concentrate	10,097	384	—	United Kingdom 160; Iran 150; Morocco 54.
Metal including alloys, all forms	42,902	48,222	3,264	Australia 37,852; Zambia 1,160.
Magnesium: Metal including alloys, all forms	634	753	249	Norway 249; France 147.
Manganese:				
Ore and concentrate:				
Battery-grade	106	150	—	Singapore 200; Gabon 50.

See footnotes at end of table.

TABLE 5—Continued
INDIA: IMPORTS OF MINERAL COMMODITIES^{1 2}
(Metric tons unless otherwise specified)

Commodity	1984-85	1985-86	United States	Sources, 1985-86
				Other (principal)
METALS—Continued				
Manganese—Continued				
Ore and concentrate—Continued				
Metallurgical-grade	3,841	4,559	—	Singapore 2,560; Gabon 1,950.
Oxides	285	647	—	Japan 347; Belgium-Luxembourg 280.
Metal including alloys, all forms	217	235	38	China 122; Japan 48.
Molybdenum: Metal including alloys, all forms	5	6	3	Austria 2.
Nickel:				
Ore and concentrate	1,589	3,367	56	Cuba 2,270; U.S.S.R.*235.
Metal including alloys, all forms	11,881	7,507	362	Norway 1,416; U.S.S.R. 1,100; Finland 937.
Platinum-group metals: Metals including alloys, unwrought and partly wrought troy ounces	6,044	6,334	2,251	U.S.S.R. 3,858.
Selenium, elemental	2	28	18	Bulgaria 3; Japan 3.
Silver: Metal including alloys, unwrought and partly wrought troy ounces	8,584	23,148	836	West Germany 16,815; Switzerland 1,800.
Tin: Metal including alloys, all forms	17,187	14,228	2,519	United Kingdom 2,549; Spain 1,407.
Titanium:				
Ore and concentrate	229	155	—	NA.
Oxides	10,376	5,286	1,189	United Kingdom 1,596; West Germany 866.
Tungsten:				
Ore and concentrate	212	475	—	Burma 359; Thailand 54; Canada 36.
Metal including alloys, all forms	22	47	6	Canada 18; Netherlands 9.
Vanadium: Ore and concentrate ³	604	895	229	West Germany 217; United Kingdom 122.
Zinc:				
Ore and concentrate	4,955	12,550	NA	Peru 12,063; Belgium-Luxembourg 236.
Metal including alloys, all forms	63,887	80,927	1,215	Canada 12,532; Australia 11,672; Zaire 10,452.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Natural: Corundum, emery, pumice, etc.	10	6	NA	NA.
Asbestos, crude	68,827	77,874	1,751	Canada 40,678; U.S.S.R. 12,891; Brazil 8,555.
Boron materials:				
Crude natural borates	11,813	9,089	4,033	Turkey 5,036.
Oxides and acids	—	4	—	All from Japan.
Cement	267,812	321,078	—	Republic of Korea 64,628; East Germany 65,775.
Clays, crude.				
Bentonite	12	43	18	Singapore 18; United Kingdom 7.
Kaolin	107	93	35	United Kingdom 29; Philippines 18.
Unspecified	1,141	1,673	86	United Kingdom 642; Japan 497.

See footnotes at end of table.

TABLE 5—Continued
INDIA: IMPORTS OF MINERAL COMMODITIES^{1 2}
(Metric tons unless otherwise specified)

Commodity		1984-85	1985-86	Sources, 1985-86	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Diamond:					
Gem, not set or strung	value, thousands	\$855,313	\$867,310	NA	Belgium-Luxembourg \$315,882; United Kingdom \$264,381.
Industrial stones	do.	\$197	—		
Diatomite and other infusorial earth		8	23	NA	NA.
Fertilizer materials: Manufactured:					
Phosphatic ⁴		745,200	804,800	NA	NA.
Potassic		1,030,853	1,089,577	—	Canada 319,096; West Germany 263,405; Jordan 223,124.
Fluorspar		12,824	8,807	—	China 5,497; Taiwan 2,977.
Graphite, natural		245	621	7	Japan 382; Sri Lanka 153.
Gypsum and plaster		9	23	19	Belgium-Luxembourg 2; United Kingdom 2.
Magnesium compounds:					
Magnesite, crude		2	169	—	Singapore 150; Japan 12.
Oxides and hydroxides		4,805	9,517	—	Japan 6,340; Austria 1,361; Turkey 1,000.
Mica:					
Crude including splittings and waste		3	3	—	All from United Kingdom.
Worked including agglomerated splittings		12	25	5	West Germany 8; Austria 7.
Phosphates, crude	thousand tons	1,593	1,849	407	Jordan 827; Morocco 306.
Phosphorus, elemental		96	222	—	United Kingdom 107; China 50; West Germany 44.
Pigments, mineral:					
Natural, crude		19	30	NA	NA.
Iron oxides and hydroxides, processed		370	197	—	West Germany 111; Iran 80.
Potassium salts, crude		13,000	55,006	—	All from West Germany.
Precious and semiprecious stones other than diamond: Natural:					
Emerald	value, thousands	\$7,577	\$11,764	\$7,401	Zimbabwe \$761; Switzerland \$719.
Other	do.	\$1,756	\$11,997	\$6,117	France \$1,060; West Germany \$987.
Salt and brine		7,355	37,704	269	Pakistan 37,424.
Stone, sand and gravel:					
Dimension stone, all forms		60,399	256	(⁵)	Italy 137; Nepal 118.
Quartz and quartzite		53,784	70,775	NA	Japan 69,044; Bangladesh 1,621.
Sand other than metal-bearing		2,016	872	778	Australia 36; United Kingdom 30.
Sulfur: Elemental:					
Crude including native and byproduct		1,153,089	989,860	63,153	Canada 358,003; Saudi Arabia 266,028.
Colloidal, precipitated, sublimed		221	28	—	West Germany 21; Japan 5.
Talc, steatite, soapstone, pyrophyllite		15	157	—	Nepal 135; United Kingdom 5.

See footnotes at end of table.

TABLE 5—Continued
INDIA: IMPORTS OF MINERAL COMMODITIES^{1 2}
 (Metric tons unless otherwise specified)

Commodity	1984-85	1985-86	United States	Sources, 1985-86
				Other (principal)
MINERAL FUELS AND RELATED MATERIALS				
Coal, all grades including briquets thousand tons	543	2,396	—	Australia 2,295; Canada 38.
Coke and semicoke	17,163	53,028	—	Australia 40,882; Japan 12,134.
Petroleum, crude thousand 42-gallon barrels	98,430	111,924	—	Iran 25,471; U.S.S.R. 18,890; Saudi Arabia 17,597.

¹Revised. NA Not available.

²Table prepared by Audrey D. Wilkes.

³Data are for Indian fiscal years Apr. 1 through Mar. 31 and have been compiled from the Indian Minerals Yearbook 1989.

⁴May include other unspecified ores.

⁵P₂O₅ content. Data from the Fertiliser Association of India, New Delhi, Fertiliser Statistics, 1987-88, pp. 1-172.

⁶Less than 1/2 unit.

to a little over 67,000 tons for the year against a targeted 130,000 tons and an expected 100,000 tons, the difficulties seemed to have been overcome.

Meanwhile NALCO's alumina operations went smoothly during the year, with expected 1988 production in the 550,000-ton range, compared with 167,000 tons the year before. This was far from its rated capacity of 800,000 tons per year. NALCO's Andhra Pradesh bauxite project, however, remained sidetracked by the Government of India since the previous year as negotiation proceeded on custom bonding for the project. NALCO posted a bond with the state forestry authorities for enumeration of trees in the proposed mining area, and an agency was appointed for a peg-marked survey of the area.

The Bharat Aluminium Co. (BALCO), in the public sector, was facing closure in 1 year, or at most 2 years. Its bauxite reserves at Amarkantak and Phutkapahar were running out and its new Gandhamardan bauxite project was embroiled in squabbles involving environmentalism, religion, politics, and apathy. Since 1983, BALCO has battled charges of environmental pollution, ecological imbalance, damage to temples, and uprooting of tribal people plus deprivation of their livelihood. Against these

charges, BALCO has promulgated a program of reclamation of mined-out areas, reforestation with a nursery capacity of 40,000 saplings per year, and various other welfare and development activities intended to compensate for the effects of mining. Other producers declared their support of BALCO, asserting their willingness to commit shares of bauxite or alumina if BALCO exhausted its reserves before the Gandhamardan disputes were resolved.

Power shortages continued, restricting BALCO's aluminum output to about 66% of installed capacity. The Government of India, seeing little prospect of improving the ability of the state and national power grids to deliver electricity to the aluminum smelters, gave BALCO permission to install its own 270-MW power facility. NALCO already had set up its 500-MW plant at Angul. A private-sector company, Madras Aluminium Co. (MALCO), faced closure because the Tamil Nadu State government did not accept a recommendation for increasing power supply to the languishing company. A fully integrated company producing 27,000 tons per year of alumina and 13,800 tons per year of ingots, extrusions, and wire rod, MALCO was supported by various financial institutions in an effort to make the company

profitable. However, the State government would only consider raising MALCO's energy quota if the company was prepared to pay stiff increases in energy tariffs and compete with the power needs of other industries. India was endowed with bauxite reserves estimated at 3 billion tons but, primarily because of power shortages, continued to import aluminum to meet domestic demand.¹⁶

Chromium.—Production by Indian Charge Chrome Ltd. (ICCL), a totally export-oriented operation promoted by Indian Metals and Ferro Alloys Ltd. (IMFA), was scheduled to begin at the end of the year at its plant at Chowdwar, in Orissa State. Built with assistance from Elkem of Norway, the plant had a production target of 62,500 tons per year. IMFA already produced charge chrome at its Therubali plant in Orissa's Koraput District. ICCL operated mines in the Sukirda-Nausahi ore belt of Orissa, one of the world's richest deposits of high-grade chrome ore.¹⁷

The Government of India's Secretary of Mines announced that new discoveries of chrome ore totaling 3 million tons had been found in the Sukinda area. This brought Orissa's total reserves to more than 137 million tons of chromite ore and India's reserves to at

least 140 million tons and perhaps closer to 150 million tons if consideration were given to smaller deposits in Karnataka, Bihar, and Tamil Nadu.

Cobalt.—India was not a producer of cobalt but consumed about 270 tons per year, imported from Zambia. In 1988, India planned domestic recovery as a byproduct of lead and zinc at Hindustan Zinc Ltd.'s operation at Udaipur, Rajasthan, where the ore was said to contain 0.0024% cobalt. At last year's throughput, this would have been enough to yield 25 to 30 tons of cobalt and displace that much in current and lost foreign exchange. Significantly, the Bhaba Atomic Research Centre provided the technical expertise for this plant, scheduled to go on-stream in 1989. Other byproduct recovery operations were projected elsewhere, including a pilot plant built by Sandvik Asia at Pune to recover about 10 tons per year of cobalt from copper, nickel, and zinc scrap.

In the early 1980's, the Geological Survey of India (GSI) completed its exploration for cobalt- and nickel-bearing laterites in the Kalimati-Bichaburu area of Singhbhum District, Bihar. The Survey estimated reserves there of 5.33 million tons containing 0.01% to 0.06% cobalt.¹⁸

Copper.—In accordance with the proverb that a rising tide lifts all boats, the world increase of copper prices lifted India's copper-mining industry out of its economic troubles.

After considerable study of recurrent problems centering on modest ore grades and lack of profitability, Hindustan Copper Ltd. (HCL), a public-sector company, was instructed by the Government of India to begin phasing out the uneconomic mines and to diversify the work force to new mines. Accordingly, HCL decided to open up Banwas in the Khetri copper complex in Rajasthan and Chapr Sideshwar in the Indian copper complex of Bihar, so that mine development began at both sites.

Smaller operations at the Ghatsila complex, also in Bihar, were discontinued, and activity at some of the leaner ore blocks at Khetri was redirected to other sites where roughly 15 million tons of ore grading 1.7% copper were found. HCL initiated detailed studies of the Singhbhum copper belt in Bihar and proposed similar studies for determination of copper reserves in Madhya Pradesh. Other efforts were underway to modernize and upgrade the two sets of smelters and refineries at the Khetri complex and bring their yearly output up to full capacity at 31,000 and 16,500 tons per year of improved-quality copper with better byproduct recovery. Long-term measures by the Government of India included increased research and development in technology for better performance and higher recovery. These actions were all intended to enable HCL to raise its yearly production of copper from the current level of about 48,000 tons per year to 70,000 tons per year by 1990 and so cut back on imports.

Further to the above changes and improvements, HCL planned to expand its operations at Malanjkhand in Madhya Pradesh to underground extraction from surface mining alone of ore there which, at approximately 1.4% copper, ranks among the best in the country, with reserves projected at 287 million tons. HCL acknowledged, however, that it sees little possibility of meeting the Government's 1990 target.

Within the Government of India, which was not especially committed to a market-driven price dynamic, controversy continued over the setting of domestic copper prices. The Bureau of Industrial Costs and Prices (BICP) submitted its report, "The Normative Cost of Copper Production," to the Ministry of Steel and Mines, which in turn asked BICP to propose a pricing policy for copper in India based on the cost of production at HCL, import costs, and (whatever it could be taken to mean) the overall interests of consumers.¹⁹

Near the end of the year, it became

clear that favorable world-market prices had overwhelmed artificial pricing efforts by the Government of India. All HCL production figures equaled or exceeded targets. For a record output of 5 million tons of ore, the company scored new highs in production and sales, the latter having climbed 48% from 1987 to a value just less than \$26.1 million. Capacity utilization ran about 94%, a significant improvement over that of previous years, and productivity per worker-year improved to a level 30% higher than that of 4 years before.²⁰

Final developments in 1988 included the discovery of copper in Chitradurga, Raichur, Hassan, and Gulbarga Districts of Karnataka State; the establishment of a 60,000-ton-per-year continuous-cast copper-wire-rod plant at Taloja in Maharashtra State; and the Government's granting of a letter-of-intent (but not yet an industrial license) to a private-sector firm, Apurv Bagri, to set up a 15,000-ton-per-year continuous-cast copper-rod plant at Raigarh in Madhya Pradesh.

Gold.—Gold smuggling was on the rise in 1988, amounting to about 40% of the value of all contraband confiscated at points of entry and estimated by Indian officials at roughly 100 tons per year. Much of the impetus for smuggling was attributable to the Indian national policy of prohibiting the import of gold other than for small amounts devoted to the jewelry trade. Domestic black-market gold prices as high as 70% above the world price thus provided incentive to the entrepreneurs of the business of illegal importing. As domestic production amounted only to about 62,822 ounces of gold in 1988, the estimated 100 tons or so smuggled into the country evidently helped fill a large gap between production and demand. As the country endured a declining rupee and currency restrictions, many of its citizens sought gold as a way of protecting their wealth.

Production of larger quantities of gold was one of the known palliatives

for such a situation, but rising operating costs, depletion of higher grade ores, and declining overall reserves caused a steadily decreasing profitability in India's gold mines. In an effort to alleviate the situation, Bharat Gold Mines Ltd. (BGML) was newly authorized by the Government of India to sell 1 kilogram (kg) of gold per year, each, to private dealers at artificially high domestic prices. Until then, the Government of India had bought all BGML output at much lower prices, which amounted to about 47% of the actual production cost. The new policy had little or no effect. In order to survive, BGML was forced to diversify into mine construction, shaft sinking, and the manufacture of tools for the mining industry. After having produced 267 tons of gold as of 1988, BGML was forced to close some mines and phase out workers at the rate of about 500 per year. Only the Mysore, Champion Reef, and Nandidurg mines approached economic viability, but under the circumstances needed ore grading 7 to 8 grams per ton (g/t) to be profitable.

An accelerated exploration effort by the Government of India focused on several states, including Karnataka, Andhra Pradesh, Bihar, and Maharashtra. Proven foreign technology was sought to aid the GSI and the Mineral Exploration Corp. in their search for new deposits.

Late in the year, a discovery in BGML's Kolar Mine began to change the outlook for the company and to some extent for the nation. Relatively rich mineralization on the order of 6.5 g/t was found while blasting underground at a relatively shallow level. Although first reports were sketchy, the ore zone was thought to be 2.5 meters wide and to extend 3 km beneath the surface. Meanwhile the GSI and the Karnataka State Department of Mines and Geology jointly located new deposits of gold grading 4.8 to 6 g/t in Kolar, Raichur, Hassan, Tumkur, and Dharwar Districts. Although these events did not alleviate the national problem

of artificial pricing for gold, nor the vigorous smuggling operations in response to those prices, they did bode well for continued economic life for the gold-mining companies.²¹

Iron Ore and Pellets.—Production of iron ore increased slightly over that of the previous year, rising about 2.5% to a total of 52.3 million tons. Early in the year, Romania signed a new protocol with MMTC agreeing to import 5 to 6 million tons per year of Indian iron ore through the year 2000. This protocol replaced a previous agreement for 4 million tons per year that Romania unilaterally cancelled because of various difficulties it had in assembling enough rupees or hard currency to meet payments. About 3 months later it was said that Romania might import something on the order of 3.5 million tons, versus the intentions expressed above. An erratic customer, Romania itself may not know what it can afford from year to year in iron ore imports from India. Japan, MMTC's best customer for the ore, signified its intention of importing 10 million tons in 1988 but balked momentarily at a price increase requested by the Government of India. Press reports speculated that MMTC's iron ore exports might total 17 million tons for 1988 after the Republic of Korea indicated it was willing to raise its long-term commitment to buy from 3 to 4 million tons of iron ore annually. Another 9 million tons was exported by private-sector sources.

The other major player in iron ore exporting, the state-owned Kudremukh Iron Ore Co. Ltd. (KIOCL), successfully broadened its export market and perhaps finally overcame the impact of revolutionary Iran's failure to honor the Shah's promise to purchase the entire KIOCL production. After exporting approximately 3.2 million tons of iron ore concentrates and 800,000 tons of pellets to some 15 different countries in 1987, KIOCL in 1988 agreed to export 1 million tons of con-

centrates annually to Bahrain. Rumors of Saudi Arabian interest in importing a small amount on a trial basis were followed by expressions of interest by Austria and Taiwan. Here Romania appeared again by agreeing to import 1.6 million tons of pellets in 1989. Hungary likewise contracted for 1.2 million tons of pellets. It may be recalled that Romania furnished KIOCL technical and financial assistance to set up the pelletization plant for utilizing the concentrates it produced.

KIOCL iron ore concentrates and pellets played a growing role in India's total iron ore exports. From 1984 to 1987, earnings rose by a factor of three while earnings from iron ore itself remained fairly steady. Near the end of the year, Japan conceded price increases to MMTC of 17.3% for iron ore lumps and 13% for fines, and further agreed to take 12.5 million tons of ore from MMTC in 1989. Another 8 to 9 million tons of iron ore was to be exported by private-sector sources in Goa.²²

Iron and Steel.—A new feature of India's steel industry in 1988 was a high-tech startup of great interest and potential significance. Sunflag Iron and Steel, the first Government-approved integrated steel plant in the India private sector since independence four decades ago, began production in August and hot rolling at the end of the year near Nagpur in Maharashtra State, central India. The plant used ore from the Government's Bhilai iron mines, domestic coal for fuel, and established computer control of the entire operation from furnace to cold shear. With a feedstock of scrap and direct reduced iron, the 50-ton electric-arc furnace (EAF) was soon to be charged with sponge iron from the company's own plant at the same location, whose capacity was to be expanded from 150,000 to a projected 450,000 tons per year. The plant was thus the only Indian EAF plant making its own charge in the form of sponge iron. The EAF, of Mannesmann Demag design, incorporated

eccentric bottom tapping; facilities for continuous feed of sponge iron; and injection of sponge-iron fines, coke, and oxygen. A Demag ladle furnace was installed for secondary metallurgy; a three-strand continuous casting machine, also of Demag design, had automatic mold-level control, gas shrouding, and computer-controlled secondary cooling. With a capacity of 200,000 tons per year, the entire plant was tightly staffed. More than 50 local operators were trained in the Federal Republic of Germany, where much of the equipment and process technology was engineered. Although India has found it politic to keep its industries as labor-intensive as possible within the context of industrial activities, thus affording employment to an optimum number of workers at any particular site, the Sunflag plant may have decided to try fewer and better trained workers as a way of increasing productivity. Moreover, national and international interest was focused on the testing of the several new process concepts in which interlinked viability was not yet proven.

Meanwhile VSP in Andhra Pradesh, whose cornerstone was laid in 1971 by Prime Minister Indira Gandhi, was said to be nearing completion, at which time it would be India's sixth integrated and first shore-based steel plant. Under construction with technical assistance from the U.S.S.R., VSP has had a long history of problems, many of them centering on the availability of water and power supply. Generally, not more than 19 million gallons per day was drawn from the Raiwada reservoir near Vizag, much less than the latter's minimal needs of 32 million gallons per day for the blast-furnace stage and 40 million gallons per day for the rolling mills. Commissioning of the blast furnace was delayed until the Andhra Pradesh State government could ensure completion of the Yeleru water project, which was intended to supply 73 million gallons per day to VSP. Engineers at the Vizag site were confident that the water problems would be solved in time for the VSP's anticipated commission-

ing date at the end of 1989.

For the planned first-stage capacity of 3 million tons per year, Vizag needed 280 MW of electric power with a peak load requirement of 292 MW and an essential load level of about 249 MW. From its own generating facilities, VSP could assure a supply of 140 MW from a combination of thermal and waste-gas power generation, and even a peak output of 220 MW but, as a practical matter, it had to depend upon another 140 MW from the Andhra Pradesh State Electricity Board (APSEB). In the midst of APSEB's recent 60% cut to the state's high-tension-transmission power consumers, VSP officials were concerned whether sufficient power could be guaranteed for the next several years.

Because VSP was some distance from sources of raw materials such as iron ore, limestone, dolomite, coking coal, and steam coal, it planned to spend as much as \$62 million more on freight charges than similar plants elsewhere in India. Despite these problems, certain advantages were recognized. In addition to power generation from waste gases, the plant was to have 7-meter-high coke-oven batteries with dry-quenching facilities and 3,200-cubic-meter blast furnaces as compared with the 2,000-cubic-meter blast furnaces operating elsewhere in India. The plant also was to have a new system for charging the blast furnaces with raw materials, continuous casting, and computerized operations. Labor productivity per ton produced was expected to be three to four times higher than for other Indian steel plants, and management anticipated eventually increasing capacity to 5.7 million tons per year, thereby lowering unit capital costs even further.²³ The latest report was that VSP lighted up its first coke-oven battery on the last day of FY 1988.

Tata Iron and Steel Co., the oldest operating integrated iron and steel plant in India, completed a major 8-year, two-phase modernization. Phase 1 included the establishment of continuous casting

as well as the commissioning of a bar and rod mill. Phase 2 included rebuilding, respectively, the coke-oven battery, sinter plant No. 2, and an enhanced blending and bedding system. This phase also included new attention to the improvement of raw materials as Tata, which was already importing low-ash coking coal, concentrated on improving the quality of metallurgical coal from its own mines.

Besides the VSP project, the Government-owned Steel Authority of India Ltd. (SAIL) continued planning and contracting for the modernization of four of its other plants. The first plant, Durgapur, never reached its intended capacity of 1.6 million tons per year after a previous expansion more than 20 years ago. Through general repair and the re-vamping of upstream facilities including coke ovens and raw-material processing, Durgapur was targeted for a new increased capacity of 1.66 million tons per year.

The Rourkela plant, also expanded in the 1960's from about 1 million tons per year to a targeted 1.8 million tons per year, thereafter achieved slightly more than 1.5 million tons in one unusual year; actual capacity was considered to be closer to 1.1 million tons per year. After modernization in two successive phases, the newest target for the Rourkela plant was 1.9 million tons per year. The proposed financing worked out to slightly over \$2 billion to add 800,000 tons per year of crude steel capacity,²⁴ or about \$2,500 per ton of installed capacity.

Burnpur plant, operated by the SAIL subsidiary Indian Iron and Steel Co., continued talks with Japan's Nippon Steel as the leader of a proposed consortium for upgrading Burnpur. Ingot steel capacity was to be raised from 800,000 tons per year to 1.55 million tons per year at first, and later to 2.15 million tons per year. Finally, the Bokaro Steel Ltd. plant, built in the 1960's with help from the U.S.S.R., continued work on expanding its capacity to 4 million tons per year of ingot steel including 3.16 million tons

per year of salable steel. The U.S.S.R. proposed financing of a further expansion to 4.5 million tons per year of ingot steel, to include reconstruction of the converter shops, installation of continuous casting, and upgrading of the hot rolling mill. Although ingot, or liquid steel, capacity would increase by 500,000 tons per year, salable-steel capacity would thus increase to 800,000 tons per year. The U.S.S.R. would make low-interest loans available for the entire cost of the second phase of expansion.

India's Government-owned (SAIL) steel plants continued to experience problems, none of which was new. Coal from Government mines had a high ash content in the first place, but is known to arrive at the mills in short weight because of the inclusion of useless mine gob and waste, causing burning problems and lowering the relative calorific value on both a volumetric and a weight basis. Electric power was undependable and not very predictable. Some advantage accrued to on-site power generation, particularly cogeneration, but fuel-quality variations would not automatically go away. Lack of flexibility in changing product mix with changes in demand suggested an unresponsive managerial structure, along with outdated equipment. Low profitability was an inevitable consequence of these problems, but with an excess of employed workers whose large numbers were not necessary to the production of steel, profitability deteriorated further.

Lead and Zinc.—Output of lead concentrates was down almost 16% to 39,898 tons, with zinc concentrates up 6% to 111,430 tons produced in 1988. Primary metallic lead output was down 9% at 18,833 tons while primary metallic zinc was virtually unchanged at 68,940 tons. Output of secondary lead was up 15% at 14,000 tons even. Not much growth occurred in the lead-zinc industry during the year. As in previous years, changes for the better were more anticipated than realized, but in 1988

some critical steps were accomplished.

Hindustan Zinc Ltd. (HZL) finally received clearance from the Government of India to begin construction of its Rampura-Agucha zinc-lead integrated complex in Rajasthan. The project was to include an open pit mining operation delivering 3,500 tons of ore per day, grading 13.5% zinc and 1.9% lead, to a concentrator, a sinter plant, and an Imperial Smelting Furnace (ISF) smelter, the latter two at Chanderia in Chittorgarh District. The concentrates would grade plus 55% zinc and plus 50% lead, the latter somewhat low because the relatively higher proportion of lead reports as an oxide in the zinc concentrate. Yearly output was projected to be 70,000 tons of metallic zinc and 35,000 tons of metallic lead.

As byproducts, the complex was expected each year to produce 375 tons of cadmium, 176,000 tons of sulfuric acid, 74 tons of silver, 1,929 ounces of gold, 30 tons of mercury, and 10 tons of bismuth. Originally planned to cost \$412 million, revised estimates moved the total cost up to \$519 million, some \$106 million of which has been extended as a credit from the United Kingdom in the form of a loan plus a grant-in-aid. Near the end of the year Prime Minister Rajiv Gandhi laid the foundation stone of the complex; after years of delay, construction officially got underway. Actual production of lead and zinc from this facility would go far toward fulfilling India's requirements and precluding the expenditure of valuable foreign-exchange credits.

HZL also assumed the role of promoting and developing lead- and zinc-based alloys such as lead-antimony, zinc-aluminum foundry alloys, and so-called Galfan coating alloys. As a recent member of the International Lead and Zinc Research Organization (ILZRO), HZL was empowered to petition ILZRO for authorization to produce Galfan alloy in India.

Elsewhere the Bombay-based private-sector Binani Group, operating Cominco-

Binani Zinc Ltd. (CBZL) in Alwaye, Kerala State, had nearly completed its expansion from 17,000 to 20,000 tons annual capacity. This included installation of a 22,000-ton-per-year roaster and a large electrolytic-cell house, which together cost \$36.6 million. Moreover, CBZL applied for a license to import a 5 MW, \$3.3 million diesel generator for use during power cuts imposed by the State electricity authority. During 1987, the 600-worker plant at times sustained cuts so heavy as to have lost more than 50% of the power required to operate.

The Gujarat Mineral Development Corp. Ltd. (GMDC) went forward with development of its complex-sulfide ore body near Ambamata where it planned to mine 350,000 tons per year of ore grading 5.33% zinc, 3.0% lead, and 1.12% copper by open pit methods. The company had not decided whether to produce three separate concentrates, a combined bulk sulfide concentrate, or a zinc concentrate plus a copper-lead concentrate for the new ISF smelter being installed by HZL described above.²⁵

Nickel.—After publicity in midyear to the effect that the Federal Republic of Germany offered approximately \$1.5 million to India toward equipment costs and worker training in connection with the extraction of nickel from laterite ores in the Sukinda District of Orissa, the project was halted for reevaluation. Fifteen years of work toward the goal of recovery of lateritic nickel, including construction of a pilot plant, ended when the Government of India decided not to proceed. Citing "techno-economic" reasons, thought to mean that the experimental technology failed, the need was seen for further exploration and the construction of another pilot plant at a cost of \$3.3 million. Mineralization in the Sukinda laterites grades about 1% nickel with a cutoff grade (below which mining is uneconomic) of somewhere between 0.5% and 0.7%. This suggested the necessity of including the simultaneous

recovery of cobalt and perhaps iron chromite in an integrated operation. Although determination of grade and tonnage of ore could become more complex with multiple recovery, India was a net importer of nickel (and cobalt) and has had to conserve its foreign-exchange reserves every way possible. Developments in the technology of nickel recovery from laterite were awaited with interest.²⁶

Tin.—Although India had produced and accumulated a modest quantity of tin concentrates over the past few years, there existed no domestic smelter for production of the metal. Export was prohibited because the concentrates were considered a strategic material by the Government of India and so consigned to stockpiles. No particular incentive existed to carry on organized mining even though tin deposits were known both in the Koraput District of Orissa and the proximal Bastar District of Madhya Pradesh. It was noted that tribesman in Koraput had smelted cassiterite in crucibles over charcoal and typically produced about 0.7 kg of tin from 3 kg of the oxide.

At the end of the year, however, India's first commercial production of metallic tin occurred at Saru Smelting Ltd. of Delhi's Sartin Ltd. plant, near Cuttack in Orissa State, from concentrates said to grade 65% tin. Sartin, a private company formed to take advantage of State-aided funding by Madhya Pradesh State Mining, expected to satisfy about 10% of India's tin needs by processing concentrates from the two adjoining States as well as imported concentrates from China and perhaps the United Kingdom. The Sartin smelter was built with the technical assistance of Base Metal Synergy Associates (BMSA) of Humberside in the United Kingdom. BMSA and Sartin were providing private consulting to Orissa Mining Corp. so that mine output from Koraput could be expanded.

The tin slags, reported to contain as much as 30% tantalum-columbium,

were a potentially valuable mineral commodity but, like the tin concentrates, were also considered a strategic material and consequently could not be sold or exported. The slags themselves were stockpiled and added to the tantalum-columbium slags remaining from the primitive smelting over charcoal fires. Because of low tantalum prices, a planned tantalum treatment plant was not carried forward; by the end of the year there were no further plans.²⁷

Primary tin mineralization grading about 0.29% but occurring in micron-sized particles was discovered at Tosham, near Bhiwani in the State of Haryana, northern India. Hindustan Zinc Ltd. obtained mining rights and was studying the problems of mining and processing.

Tungsten.—The Uttar Pradesh Mineral Development Corp. reported a tungsten find in Almora District of Uttar Pradesh estimated to include 10 million tons of ore grading 0.4% tungsten, said to have been verified by the Indian Bureau of Mines. Plans were made for a pilot plant to begin commercial operation in 4 to 5 years. Near the end of the year, however, the find was downgraded to 200,000 tons of material containing 0.1% tungsten trioxide. Reserves of tungsten trioxide in other States were 2,608 tons in Rajasthan, 17,666 tons in Maharashtra, 298 tons in West Bengal, 5,926 tons in Karnataka, and 62 tons in Andhra Pradesh. Not all of these reserves were thought to be large enough for commercial extraction.

The Government of India's Mineral Exploration Corp. Ltd. (MEC) has entered into an agreement with an unnamed French company for tungsten exploration in Khuchi Khobna, Maharashtra, using French exploration technology. Earlier field efforts by the Geological Survey of India indicated tungsten occurrences in Bhaonri, Ranburi, and Mokabardi, all in Nagpur District.²⁸

Uranium and Thorium.—The Chairman of the Atomic Energy Commission

of India reported a uranium discovery in Maghalaya possibly significant in terms of the apparent size of the reserves.²⁹ Other research work in India concluded that certain species of pine and juniper plants absorb uranium and selenium from the soil and could be used in geobotanical exploration to identify uranium enrichment at or near the surface.

Following a decision of the Atomic Energy Commission of India to move all facilities away from the Bhabha Atomic Research Centre that are not directly connected with Bhabha's research and development programs, a new thorium nitrate plant was proposed in Orissa. The plant, of unspecified capacity, was to be next to the Orissa Sand Complex of Indian Rare Earths Ltd., also operated by the Department of Atomic Energy.

The public-sector firm Uranium Corp. of India Ltd. (UCIL) announced plans to exploit two monazite-sand mines in Bihar State at Narwapahar and Turanmdih, which were expected to yield a combined 1,500 tons per day. The thorium content of the monazite would be a useful substitute for uranium in nuclear powerplants. In light of India's ambitious plan to increase its nuclear power-generating capacity to 10,000 MW by the year 2000, the country would need 40,000 tons of uranium annually, or the equivalent in uranium plus thorium.

Industrial Minerals.—Cement.—The Indian cement industry achieved a total output of 40.7 million tons in 1988, an increase of more than 10% over that of 1987 and a new high. This burgeoning industry did not quite equal the estimate of 43.5 million tons for the year, but did begin to realize surplus accumulation of product stocks in marked contrast to earlier days of critical shortages and consequent problems in construction. With an estimated total investment of about \$3.989 billion, the cement industry was located primarily in the southern and western regions of India where limestone was available for short haul in many

localities. Andhra Pradesh, Karnataka, Tamil Nadu, Gujarat, Madhya Pradesh, and Rajasthan included the majority of cement plants.

The impressive growth of the cement industry followed partial decontrol in 1982, which initiated a notable surge of investment from private-sector sources, some completely new to the industry. Driven by a demand that was continually ahead of supply, the industry utilized modern technology, expanded capacity, and increased both production and productivity per worker to the optimum for existing price levels. By 1988, after the establishment of many new miniplants (100 to 200 tons per day) and so-called tiny plants (20 to 100 tons per day), cement was available off the shelf. The vigorous black market in cement of 1982 had vanished, and the free flow of newly produced cement to the market resulted in lower prices, which created new problems in reducing production costs. Near the end of the fiscal year in early 1989, all controls on cement production and distribution were removed. New technologies were being studied and adapted and a more productive use of labor was mandated.

While the industry paused to allow demand to take up the slack (thought to amount to as much as 4 million tons), it was clear that further expansion would be required through the next decade or two. The per-capita consumption of cement in India was 46 kg per year, quite small compared to 240 kg in the United Kingdom, about 330 kg in the United States, 380 kg in France, and 560 kg in Japan. The world average per-capita consumption was thought to be about 200 kg per year; the probability was that India would need to expand its capacity to 100 million tons per year by the year 2000, thus affording the use of concrete for roads, canal linings, and prefabrication of construction units and modules.³⁰

Fertilizer Materials.—Production of nitrogenous and phosphatic fertilizers forged ahead during the year, both

achieving new highs. India ranked fourth in the world in the production and consumption of nitrogen fertilizers and sixth in phosphates. After more than 3 years of drought, widespread rains stimulated consumption of all fertilizers, which in turn promoted solid increases in production. The successful monsoon season relieved a burden of high stocks and low prices that characterized poor growing conditions. It also relieved the tendency of the fertilizer industry toward stagnation, as evidenced by the forced discounting of sales to buyers, shrinkage of investment from the private sector, and questions concerning the advisability of any further increases in capacity.

Still relying heavily on imports of phosphate, with undesirable consequences for foreign-exchange reserves, India witnessed renewed large-scale buying by China. This latter country's absence in the world market the previous year had seriously affected suppliers by leaving them with no buyer for their excess production. Phosphoric acid producers raised prices sharply at the end of 1988, causing the delivered price to India to climb from \$425 to \$480 per ton of phosphorus pentoxide. The Indian Ministry of Finance thereupon refused to allot monies for the purchase of phosphoric acid for the first one-half of 1989, causing confusion in the international market. As the two most populous countries in the world, China and India jointly accounted for 65% of phosphate fertilizer consumption in Asia in 1988. Given this volume, each is critical to the stability of the international market, so that the implications of these swings in purchasing policy were far from clear.³¹ It was expected that much more would be heard from Government and industry on the problem of India's imports of phosphate, and especially the negotiation of price.

Gem Stones.—Although production of combined industrial- and gem-quality diamonds dropped 11% from a total of 16,484 carats in 1987 to 14,613

carats in 1988, overall activity in diamond production, cutting, and polishing increased significantly. Gem and jewelry exports, at nearly \$2.66 billion, were about 65% higher than in the previous year and were, once again, the leading foreign-exchange earner. During the year, India imported roughly \$2.181 billion worth of uncut diamonds and other precious stones for cutting and polishing, thereby adding more than one-third to their value (versus an added-value rate of 25% in Israel)³² and affording employment to 1 million skilled and semiskilled workers. In 1988, India processed 70% of all diamonds used in jewelry and clearly intended to maintain this position; special diamond-cutting tools could be imported freely for the application of new technology at the cutting centers around Bombay and Surat. Indian cutting concentrated on the small diamonds not amenable to mechanized processing, in which Israel is the world leader.

Tax raids by the Government of India on the diamond-cutting centers toward the end of FY 1988 resulted in protest "close-downs" of the entire diamond trade for 5 days, followed by vows to close every Thursday until problems with the tax authorities could be resolved. Because these closures disrupted a booming yearend market, final export statistics for the year vary somewhat according to source. The dollar values expressed above represent an approximate median.

In Orissa, the State government promulgated a new bill to stop the illegal mining and sale of precious stones that was rampant in Bolasngir, Kalahandi, and Sambalpur Districts. Under the bill, a license would be required to possess, store, sell, or trade any mineral including precious, semiprecious, and uncut stones. The act was aimed at illegal traders of Rajasthan, Gujarat, and Andhra Pradesh who have exploited tribal people and caused a loss of revenue to the State. Orissa Mining Corp. was planning to set up new pur-

chasing centers offering fair prices to local people for gem stones and to inaugurate a cutting and polishing industry in the region.³³ Gem stone production in Orissa grew rapidly amidst the discovery of new localities, but organized mining was generally not established. In an exposed pegmatite belt comprising 2,500 square km, discoveries included green, yellow, and pink (morganite) beryl, aquamarine, rhodolite, almandine, ruby, alexandrite, and white topaz. Emerald rough of good color was found in the Patnagarh area in masses of 5 or 6 grams.³⁴

Granite.—The Bihar Government brought forward a proposal for a State-owned granite mining and processing plant in Palamau District at Daltonganj. Estimated to cost \$6.7 million, the mine and facilities were designed to produce 13,560 tons (5,000 cubic meters) of export-quality black and pink granite per year. Bihar seemed evidently to have been impressed by the success of granite ventures in Andhra Pradesh, Tamil Nadu, and Karnataka. India's granite-export industry operated at the \$66-million-per-year level in 1988 according to industry sources.³⁵

Graphite.—India continued to develop its graphite-mining industry with the hope of exporting for purposes of earning foreign exchange. In 1987, the Industries Minister of Tamil Nadu sought a license for establishing an operation for mining, cutting, and polishing graphite entirely for export. In 1988, the Bihar State Mineral Development Corp. received State approval for setting up a facility for graphite beneficiation, and proposed to beneficiate 1,500 tons annually to a purity of 96%. At the same time, work began on the State-owned Tamil Nadu plant, designed to manufacture for export 9,240 tons of graphite per year having a purity of 96% to 99%. The plant was at Sivaganga in the District of Pudukkottai, where a high-grade graphite deposit was discovered on

a 364-hectare area comprising about 200,000 tons to a depth of 15 meters. Together with other local lower grade mines the discovery was expected to give a boost to this economically backward district. Based on a total investment of \$18.3 million the entire project aimed at a 200-ton-per-day throughput that would add up to \$5.6 million per year in foreign exchange earned.³⁶

Limestone and Dolomite.—While exploring for coal, the Maharashtra State Directorate of Geology and Mining reported discovery of a limestone deposit of unknown size in Gadchiroli and Velabai Districts. In Rajasthan, a very large deposit of steel-grade limestone was discovered in Jaisalmer, bordering Pakistan south of Ramgahr and Sam. Occupying an area of 1,000 square km with only 1 meter of overburden, the deposit was estimated at 500 million tons excluding about 60% waste. Of this, the State-owned Rajasthan Mineral Development Corp. has leased an area of 10 square km for mining a deposit containing an estimated 80 million tons, but acknowledged problems of difficult terrain, lack of communication facilities, and an unwillingness of laborers to work in the interior of Jaisalmer.³⁷

The Madhya Pradesh State Mining Department discovered a high-grade dolomite deposit, from which it was thought possible to extract manganese, of about 1.5 million tons in the Kakya development block in Mandla District. Another deposit at Balaghat in Seoni District was estimated to include 300 million tons of steel-grade dolomite.³⁸

Mica.—At 3,610 tons in 1988, production of crude mica was down about 16% from that of the previous year. A new mica paper factory was proposed to be near Gudur in the Nellore District of Andhra Pradesh, where one plant was already working. The Gudur area, which has maintained a reputation for the quality and weight of its shipments, has three mines producing ruby mica and nine other mines yielding clear

mica. Some spotted mica, although available, was not in demand.³⁹

Mica Trading Corp. (MITCO) announced price increases and decided to quote in U.S. dollars. Effective April 1, 1988, MITCO arbitrarily raised scrap prices by nearly 40% in terms of rupees, but in dollar terms the increase was much less as the result of the rupee's decline in relation to the dollar. Prices per ton, f.o.b., for uncrushed mica scrap became:

Up to 1/2-inch screening	\$398.50
1/2- to 3/4-inch screening	438.50
3/4- to 1-inch screening	478.50

MITCO said it raised prices (1) to promote production of better grades of scrap and a better return to producers and (2) to encourage the reopening of mines that had closed in past years. To boost foreign-exchange earnings, according to MITCO, India was encouraging the export of value-added products such as mica powder, micronized mica powder, and mica paper. MITCO established a 2,400-ton-per-year factory at Jhumritalaiya, with Japanese backing, for manufacture of these products including 600 tons per year of mica paper. U.S. mica importers expressed concern as to the availability of scrap mica, the new higher prices, and the allocation of 50% of the Jhumritalaiya output to the Japanese. Concern was expressed that MITCO has placed a limit of \$62,500 per importer on the annual value of mica that each was permitted to buy from private Indian exporters. Orders exceeding this amount had to be shared with MITCO, which procured its supplies from many small producers whose quality commonly was not up to par. MITCO also announced that importers who had not bought from India in the past 2 years would not be served and that no new buyers would be registered.⁴⁰ It was predictable that buyers would be driven toward other markets.

Sulfur.—India's State-owned Minerals and Metals Trading Corp. (MMTC) reconsidered its intention to enter into equity participation in Costa Rican sulfur mines, based apparently on pricing that would have the effect of making Canadian sulfur as much, or more, economical. For Costa Rica to compete would have required economies of scale and, in turn, port facilities, that did not exist.⁴¹ India's Oil and Natural Gas Commission (ONGC) planned to install a total of seven desulfurization units at its Bombay High offshore natural gas production operations of Gujarat. Three units were installed, each having the capacity to produce 12.5 tons per day, or about 4,560 tons per year.⁴²

Plant-nutrient sulfur was thought to have become a critical factor in Indian agriculture, particularly for the nourishment of oilseeds such as groundnuts and rapeseeds, but also increasingly for soybeans, sunflower, safflower, and sesame seeds. The State-owned Pyrites, Phosphates, and Chemicals Ltd. mined pyrite at Bihar and Rajasthan, whose reserves were thought to include 275 million tons and 120 million tons, respectively.

Talc and Steatite.—At 382,000 tons, 1988 production of steatite exceeded 1987 production by 11,000 tons or 3%, but this did not even approach the planned increase in yearly production of between 115,000 and 200,000 tons announced by India's Golcha Group as its 1990 target. As India consumed the bulk of its own production of steatite, and because many widely scattered small mines were worked in various States, official production data were deemed incomplete. India had large reserves of steatite, talc, and soapstone, all basically the mineral steatite but called by different names depending upon minor constituents, color, ornamental aspect, and whiteness. Whatever the name, the final product was used as paper filler, dressing or filler for rubber and textiles, paint extender, and as a constituent in ceramics. In-

creasingly, steatite was used in fertilizers, insecticides, abrasives, asbestos products, insulators for electrodes, and cosmetics.⁴³ Place value was very high, in that average transportation costs were about twice the value of the product as it came from the mine, and thus short haulage to local users or consumers was typical. Large industrial users were greatly separated, and had to resort to long haulage distances.

Mineral Fuels.—Coal.—Production of coal in 1988 increased to 188 million tons, or 6% more than was produced the previous year. Opencast, or surface, mining played a growing role in total output and of itself was responsible for the continued expansion of output over the past years. In 1973, surface mining of coal at the mines owned by Coal India Ltd. (CIL) produced only about 30% as much as underground mining. By 1978, surface mining yielded almost half as much as below-ground extraction; in 1985, it exceeded underground production by 16%. By 1987, the equivalent figure was 69% and it was expected to be at least 66% for 1988. In general, the output of coal from CIL's underground mines has ranged from 51 to 63 million tons per year while surface mining has climbed steadily from 18 to 106 million tons per year, thus accounting for the bulk of the growth of this industry. Although other private-sector companies and State joint ventures mine coal in India, CIL accounted for 85% of total production in the latest year for which a detailed breakdown is available, 1987.⁴⁴

Output of coal per worker per shift (OWS) in this large and sprawling industry increased very slowly, having only recently exceeded 1 ton and, for 1988, was perhaps fractionally more than 1 ton based on all sources. Even more than the fact that most (if not all) Indian coal contains very high ash, this low OWS testifies to the difficulties of mining coal economically in the country. Compared to high-speed, unit-shift, completely mechanized mining in

such places as western Kentucky in the United States, where 13 workers produce 800 to 1,000 tons of coal per 8-hour shift, affording an OWS of 60 to 75 tons, the Indian situation points up the absence of technology and mechanization. Opencast mining, by its notable growth in output, virtually assures that economies of scale are being realized through some degree of mechanization, probably bulldozing of overburden followed by dragline recovery. At an underground OWS of around 1 ton, it begs the question of whether the discounted future value of operations of the typical underground coal mine would not involve negative numbers. While the coal produced was critical to India's economy, even high-quality coal produced by these methods would not compete in world markets.

Efforts were made to improve technology and mechanization, particularly underground. With only 11 powered-support longwall faces in operation during 1988, plans were advanced to acquire 100 such longwall machines by 2000. Foreign technology for thick-seam mining by sublevel caving and multislicing was being adopted. Indigenous procurement of new machinery and equipment from both public and private sectors approximated 80% of the total. The other 20% were imports, obtained only where bilateral assistance was funded by the World Bank. Standardization of sizes and specifications of equipment was emphasized, together with the establishment of spare parts depots and manufacturers' centers for service and support of deployed equipment owned by the coal companies.⁴⁵

Exploration for new coal reserves was pressed vigorously for much of the year, centering on metallurgical coal for the steel sector of the economy and power-grade ("steam") coal for the generation of electric power. From April to December, 245,000 meters of drilling were accomplished, based on geology and geophysical techniques including downhole wireline logging, magnetic surveys, temperature and resistivity measurements,

and seismic and gravity studies. New coal reserves were established to the extent of 2.104 billion tons proven and 118 million tons indicated,⁴⁶ certainly a welcome achievement in the light of India's dependence upon this energy source. With a labor force headed toward 850,000, however, it was not easy to see how even radical improvements in technology and mechanization could help productivity sufficiently to offset the burgeoning wage bill.

Lignite.—Production of lignite rose to 8.4 million tons in 1988, an increase of 100,000 tons or a little more than 1% over the previous year's output. Five new mining blocks were found in the Neyveli Lignite Corp. (NLC) area. In addition to the 3.3 billion tons projected at Neyveli, reserves were placed at 1.5 billion tons in the Bahur area of the Union Territory of Pondicherry and Jayakondacholapuram area of Tiruchy District of Tamil Nadu. Together with reserves of 220 million tons in the Kutch and Broach Districts of Gujarat; 573 million tons in Bikaner, Barmer, and Nagaur Districts of Rajasthan; 90 million tons in Jammu and Kashmir; and a few smaller minable occurrences, the grand total of lignite reserves was about 5.8 billion tons; even this total was being augmented as exploration continued.

Petroleum.—Once again, new production offset decline rates in established production to enable a new high of 230 million barrels of crude produced in 1988, but the increase over 1987 was only 10 million barrels or slightly more than 4%. This does not match the yearly increase in domestic demand of at least 7% by an energy-starved economy, so that ideas of self-sufficiency in oil for India seem to be contingent upon future drilling and discovery. Although an output of approximately 337 million barrels per year was predicted by Indian officials for the end of the eighth 5-year plan in 1994-95, the year 1988 demonstrated once again

that new discoveries do not simply add to the initial production from previous discoveries. Decline curves for each well and each reservoir exerted their inexorable effect on production statistics.

India's Oil and Natural Gas Commission (ONGC) planned to increase production substantially in the western offshore area over the next 6 years, but this assumed availability of production that as yet has not been clearly defined. Much exploration and subsequent drilling, however, remained to be done in the area around the Bombay High and southward to the southern tip of India. New discoveries in the western offshore area would depend on progressively increasing sophistication of the exploration effort.

Of the 27 new lease blocks flanking the coastline from Panaji (on the west coast south of Bombay) around the south point of India and up the east coast essentially all the way to Calcutta, 9 had been taken up, as of the end of 1988, by major companies since the bidding had opened in 1986. Contract terms in this third round of bidding were changed to stimulate more interest in exploring these waters. For example, signature bonuses were abolished and, although permit holders had to assume the entire cost of exploration, they could terminate their holding if they deemed seismic-survey results to be negative. ONGC had the right to a 40% interest in any fields discovered, taken out of production. Also, foreign operators had to offer any crude remaining after cost recovery to the Indian Government for purchase at world prices until India achieved self-sufficiency in crude-oil production.⁴⁷ It was anticipated that a fourth round of bids would be invited from foreign oil companies, probably in late 1989, for both onshore and offshore sites, unlike the previous rounds that focused on the offshore areas only. It was thought that terms of the fourth round would be similar to those of the third. Good offshore performance thus far by foreign companies, compared to a very

modest record of onshore exploration success by the domestic companies, suggested a potential solution to India's increasing energy shortfall in the midst of its financial strictures. Although this was seen to involve relinquishing some proportion of profit to the foreign companies on oil in reservoirs not yet found, it reinforces an old saying among U.S. oil operators that "... a fair share of something is better than 100% of nothing," learned the hard way again and again. It could be added parenthetically that for exploration and production in India it was not only a matter of hardware technology transfer; real success has tended to arise also from decisionmaking by oilfinders with years of experience.

Successes there were in 1988. Offshore discoveries occurred in several places starting with a good one in the Cauvery Basin off Tamil Nadu, where a well designated PY-3-2 gauged at 2,740 bbl/d of crude increasing to 4,500 bbl/d a month later. With the oil came 1.97 million cubic feet per day (cf/d) of gas. This oil tested as a light, high-quality crude at 40° API gravity. Off the west coast, southwest of Bombay City and about 15 km due south of the Ratna field the so-called R-10 structure delivered an initial 2,227 bbl/d of crude and 781,000 cf/d of gas for a new-field discovery. North of Bombay City, off Daman, the SD-1 structure yielded a find of 1,025 bbl/d of crude along with 7.8 million cf/d of gas. Nearby, the SD-4 structure tested at 1,000 bbl/d of crude with 3.1 million cf/d of gas. Lastly, offshore, the Ravva-3A structure, formerly the GS-16, flowed 1,020 bbl/d of crude and 5.3 million cf/d of gas.

Onshore discoveries included two in Assam. The first was in the Cachar Hills of Karimganj District, where 3.9 million cf/d of gas was encountered; the other was at Sonari in Sibsagar District where ONGC tested a discovery at 700 bbl/d of crude and 706,000 cf/d of gas. Far to the south in Tamil Nadu at Narimanam in Thanjavur Dis-

tract, ONGC announced a find that tested at 350 bbl/d in the onshore extension of the Cauvery Basin.

In western India, Oil India Ltd. announced a find in its first test in western Rajasthan, where the Tanot No. 1 well in Jaisalmer District (almost on the Pakistan border) gauged at 1.6 million cf/d of gas. Near the end of the year, in Gujarat State 100 km south of Baroda, the Nada structure in Broach District yielded a test of 2,010 bbl/d of crude and 4.5 million cf/d of gas from Nada No. 1 well, thus tentatively becoming the largest onshore producer in India's history. This structure was within the onshore extension of the Cambay Basin, notable for its offshore inclusion of the Bombay High. Finally, In Andhra Pradesh, about 25 km southeast of Rajahmundry, a gas strike testing at 5.4 million cf/d was brought in by ONGC on the Mandapeta structure in the first well drilled.⁴⁸

In all, a total of 472 wells comprising 3.4 million feet of hole was drilled in India during 1988, an increase of 16% in wells and 7.5% in footage over those of the year before.⁴⁹ It became increasingly clear that India offered good petroleum prospects in various parts of the country, and that plenty of wildcat testing was justified along with development drilling if the country were to come to terms with its energy deficiencies.

India was in the final stages of negotiating a \$325 million loan from the World Bank to finance various petroleum development projects.⁵⁰ It was hoped that this funding, along with capital invested by foreign oil companies, would accelerate India's curve of discovery.

NEPAL⁵¹

The mining sector contributed only minimally to the economy of this landlocked, overcrowded nation. Only 1% of the population derived their living from the industrial sector and just a

small proportion of those were employed in mining or mineral processing.

Nepal is a land of contrast. Its terrain varied from the highest mountains in the world to almost sea level plains. In its agrarian economy, over 93% of the population was engaged in subsistence agriculture. The nonagricultural labor force was 600,000 out of a population of 17.5 million. Rural, isolated villages are common where life goes on much as it did 100 years ago and annual per capita income may be \$20,⁵² if the figure is even meaningful where cash transactions are seldom involved in the day-to-day living. In contrast, the modernized capital or cities along the Indian border may have per capita incomes up to \$600.

In order to promote development and trade the industrial policy act has been rewritten, emphasizing both direct foreign investment and export promotion. Both the Government and private entrepreneurs actively seek joint ventures in all areas.

The volume of foreign trade in FY 1987 increased by 22.8% to \$720 million.⁵³ Imports of \$550 million and exports of \$170 million gave a trade deficit of \$380 million. Magnesite, talc, and marble were the main mineral exports in order of value and probably accounted for less than 3% of total export value. Mineral imports were much more significant and consisted mostly of mineral fuels, chemical fertilizer, and construction materials in estimated descending order of value.

Nepal's first petroleum exploration well could be spudded early in 1989. In light of the country's chronic economic problems, a commercial petroleum discovery would make an important contribution to its foreign exchange, even if it was very modest by world standards.

The Foundry Development Project, a 470-ton-per-year foundry, was expected to be converted into a limited company during 1989. The project was started in 1984 under an agreement between His Majesty's Government and the United Nations Industrial Development Organ-

ization. The plant has added hand water pumps and tubewell parts to its other products on a trial basis. It is equipped with sophisticated (for Nepal) machines for building accessories and replacement parts for local equipment. Grinding balls for the cement mills are a large potential output. Raw materials for the foundry consist of locally derived scrap from vehicles and textile industry equipment and imported coal, bentonite, foundry sand, and scrap. Budget problems and a shortage of skilled labor have prevented the plant from running at its modest capacity during the year.⁵⁴

Nepal Metal Co. Ltd. continued its slow progress toward opening the country's first commercial-scale metal mine. Near the end of the third quarter of FY 1988, the company announced the offering of 2.4 million shares of common stock at Rs10/share to the general public. Other owners included His Majesty's Government, Hyderabad Industries Ltd. (India), K.K. Bamford & Co. Ltd. (Hong Kong), Mutual Trading Co. Pvt. Ltd. (Nepal), and other Nepalese investors. The cost of the project was put at \$1.6 million which apparently includes only the mine and mill costs. A considerable outlay has already been made in the yet-to-be-completed motorable road to the mine and millsite. Construction of the road from Trishuli to the southern part of the Sordang valley has been completed, leaving 12 km to be constructed to the site. His Majesty's Government was constructing the remaining road on a priority basis. The erection of power transmission lines from Trishuli to the southern part of the valley and construction of the transformer building have been completed. The manually excavated mine adit has been under construction for a number of years. In May 1987, the 1,430-meter tunnel intersected the ore body and samples showed a higher grade ore than indicated by surface drilling—15.7% zinc, 1.62% lead, and 30 grams of silver per ton. Original estimates were, respectively, 11.86%,

1.66%, and 14 grams. Ore reserves were estimated to provide a mine life of 13 years versus 8 years originally.⁵⁵

The Industry Minister attended the opening of the D.M. Brick and Tile Factory at Lubhu near Lalitpur in the Kathmandu Valley. The plant was designed and built with Chinese technical assistance at a cost of \$850,000. The capacity of the plant was 10 million brick per year or about 8% of the needs of the Kathmandu Valley. In addition, Chinese firms were planning to set up two more brickworks and a window-glass factory in support of an increasingly active construction industry.

The Himal Cement Co. operated successfully after recently doubling its original 160-ton-per-day capacity. The plant produced more than 59,000 tons

during FY 1987. At a ceremony marking the 15th anniversary of the company's opening, the Minister for Industry suggested that the capacity be further raised to 500 tons per day. He also said that the company, as well as other industries with major share holdings by His Majesty's Government, should be converted to private ownership.

Site preparation has begun on the Udayapur Cement Industry property. Work on the plant and limestone mine is to begin in 1989. The rotary kiln facility was being built under a 1987 agreement between His Majesty's Government and the Overseas Economic Cooperation Fund of Japan. It will be the third and largest cement plant in the country. Limestone reserves at the Jaljale Mine were sufficient for 160 years

of production.⁵⁶

The jointly owned Nepal Government-Orissa Industries Ltd. (India) magnesite company commissioned the dead-burnt magnesite plant at Lamosangu, 85 km east of Kathmandu, in July 1988. The plant is to produce 50,000 tons per year of 92% to 96% MgO dead-burnt magnesite and 10,000 tons per year of talc.⁵⁷ The mine has been operating on a relatively small scale for several years. The mine and processing plant have 500 workers and generate indirect employment for another 2,000 persons. The long-planned refractories plant has been delayed until economic conditions improve.

The Department of Mines and Geology planned to open a second round of bidding for petroleum exploration acre-

TABLE 6
NEPAL: PRODUCTION OF MINERAL COMMODITIES^{1 2 3}

(Metric tons unless otherwise specified)

Commodity	1984	1985	1986	1987	1988 ^p
Cement, hydraulic	39,225	31,479	92,853	151,631	215,010
Clays for cement manufacture	*2,000	4,242	6,798	*10,000	8,033
Coal: Lignite	7,595	6,808	4,536	5,081	8,311
Copper ore:					
Gross weight	*9	6	*6	*6	9
Cu content	*3	2	*2	2	3
Gem stones:					
Garnet kilograms	*20,000	27,300	*25,000	*25,000	*25,000
Tourmaline do.	*12	60	*50	*50	22
Lime, agricultural	7,000	7,000	584	*500	21,200
Magnesite, crude	14,603	19,851	63,190	38,388	45,000
Salt	700	7,500	*7,000	*7	6
Stone:					
Limestone	*45,000	55,953	174,798	334,270	323,584
Marble:					
Chips	609	700	*700	11,644	1,164
Cut square meters	*3,000	7,641	10,442	15,847	15,855
Craggy do.	708	691	3,590	6,168	6,171
Talc	7,595	6,015	*8,780	3,539	4,430

* Estimated ^p Preliminary ^r Revised.

¹ Table includes data available through Aug. 18, 1989.

² In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

³ Data are for the fiscal year ending mid-July of that stated.

age in April 1989. The opening is to be accompanied by offering 970 line km of high-resolution seismic data recently acquired in Blocks 6 through 9 by Petro-Canada International Assistance Corp. under a bilateral aid agreement. The first round offering in 1985 included 1,250 line km of reconnaissance survey.

The southern border area of the country has been divided into 10 exploration blocks, of which, Blocks 1 through 9 will be offered. Block 10 is currently held by a production-sharing joint venture between Shell Exploration (Nepal) B.V. and Triton Energy Corp. (United States) and the Department of Mines and Geology signed in 1986. Shell-Triton has essentially completed detailed seismic and surface geology studies of the block and was preparing to spud its first well in the spring of 1989. In September 1988, Texaco Inc. received exploration permits to conduct surface geologic field studies prior to determining whether to make a bid for one of the exploration blocks. The study and laboratory analysis was to be completed prior to the spring 1989 offering.

PAKISTAN⁵⁸

In current prices, Pakistan's GDP reached \$38.5 billion in 1988.⁵⁹ While the annual growth in the economy has averaged about 6.5% in real terms during this decade, Pakistan is not a wealthy country. The per capita GDP was only \$370, reflecting a growth of about 3%. Because of a high annual population growth rate of 2.9% and a low ratio of natural resources to the country's population, overcoming poverty remains a formidable task.

Pakistan's mineral industry was dominated by fossil fuels, constituting more than 95% of the total value of its mineral production. The output of natural gas in 1988 was valued at \$1.4 billion, followed by oil at about \$0.4 billion and coal at \$0.1 billion. By world standards, there is

only modest output of a wide array of minerals that are, however, significant to the local economy. Agriculture is the principal sector of economy, employing over one-half of the work force and accounting for about 25% of the GDP. Manufacturing accounts for about 20% of the GDP, and output in this sector includes tonnage quantities of cement, chemical fertilizers, and steel, again important only in terms of the local economy.

The value of the Pakistani rupee (PRs) has eroded each year since fixed parity was abandoned on January 8, 1982. Since that time, the decline in 1988 was more precipitous than in any previous year. In January 1988, the parity to the U.S. dollar was PRs17.51. On November 2, the State Bank of Pakistan, which is responsible for managing the float, revised the parity to PRs18.65 and then, on November 8, adjusted the rate to PRs18.70. As a result of the revision, the rupee conceded ground to almost all foreign currencies. The steady erosion in rupee value may be partly due to a deliberate Government policy to boost exports and to strengthen the country's balance-of-payment position. Pakistan's export income is heavily dependent on cash crops, principally cotton and rice. Shipments of these commodities account for about 40% of the total value of exports. Hence, its economy is subject to the vagaries of nature and foreign import quotas or duties and tariffs. Imports of oil and petroleum products, machinery, transport equipment, and iron and steel manufactures contribute heavily to Pakistan's trade deficit.

Production

Pakistan's largest mining sector, in terms of value, was fossil fuels. However, by world standards, the output of crude oil and natural gas was small, while the annual mine output of coal averaged less than 2.5 million tons. Mine output of metalliferous ores was also small in quantity and limited to bauxite and chromite. Mine production of antimony

and manganese was sporadic as well as negligible in quantity. The largest quarrying operation was stone, followed by sand and gravel. Production of various clays—bentonite, fire clay, fuller's earth, and kaolin—dominates the remaining mine output of industrial minerals. Annual production of salt was about 1 million tons, and that for gypsum approached 0.5 million tons. In addition, there was mine production of barite, celestite, chalk, emery, feldspar, fluorspar, magnesite, ocher, phosphate rock, soapstone, and sulfur, each of which was in inconsequential quantities. The manufacture of cement and chemical fertilizers was the dominant component in the industrial mineral sector. Metals production is limited to iron and steel and refining of secondary lead.

Trade

The value of Pakistan's total trade increased from \$8.5 billion in 1986 to \$9.0 billion in 1987, the most recent year for which complete trade data are available. In 1987, total exports were valued at \$3.7 billion, and imports were valued at \$5.3 billion, reflecting a trade deficit of \$1.6 billion. Pakistan has an agrarian economy. By extension, its major industries, aside from cement and steel, are agriculturally oriented. Its major export commodities are agricultural-derivative products, which collectively account for more than 30% of the total value of exports. Because Pakistan lacks a broad industrial base, it must import high-value manufactured goods. Its major import classes in descending order of value are plant and machinery, transport equipment and vehicles, petroleum and refinery products, and iron and steel manufactures, which collectively account for over 50% of the total value of imports. Hence, Pakistan's foreign trade historically reflects a negative balance of trade. The country's annual foreign trade deficit during this decade is shown in the text table, in billions of dollars.

Year	Annual deficit	Cumulative deficit
1980	\$2.3	\$2.3
1981	2.4	4.7
1982	2.7	7.4
1983	2.5	9.9
1984	2.8	12.7
1985	3.2	15.9
1986	2.4	18.3
1987	1.6	19.9

In 1987, the major export commodities were cotton yarn and thread, \$492 million; raw cotton, \$431 million; cotton fabric, leather, and carpet, \$754 million; and animal and vegetable commodities, \$210 million. The major import commodities in 1987 were machinery and transport equipment, \$1,547 million; chemicals, \$886 million; minerals, fuels, lubricants, and related materials, \$832 million; animal and vegetable commodities, \$789 million; and various manufactured goods classified by materials, \$645 million.

Based on value, the largest export market was Japan, followed by the United States, the United Kingdom, the Federal Republic of Germany, and Italy. The largest receipts were from Japan, followed by the United States, Kuwait, the Federal Republic of Germany, and the United Kingdom.

Commodity Review

Metals.—Pakistan has a very weak metalliferous minerals resource base. There were a number of small operations for mining metal-bearing ores for antimony and manganese. The annual output of each was very minor as well as sporadic. The only established metal-producing sector was iron and steel and shipbreaking. Pakistan must import iron ore, ferroalloying ingredients, and scrap metal to meet the requirements of its single iron and steel complex as well as import virtually all of its requirements for nonferrous metals.⁶⁰

Aluminum.—About 2,500 tons of bauxite were produced at Manshera and Khusab, both southwest of Rawalpindi. The Manshera operation accounts for more than 75% of the annual output.

Chromium.—There were numerous small operations for the mining of chromite around Hindubagh, north of Quetta. In recent years, annual mine output has varied from 3,000 tons to 10,000 tons.

Copper.—In October 1988, Resource Development Corp. (RDC) and China Metallurgical Construction Corp. (CMCC) ratified a cooperation agreement for the construction of a smelter utilizing ore to be mined from the copper deposit at Saindak. Under the terms of the agreement, CMCC agreed to build a smelter that excludes infrastructure on a turnkey basis at a fixed cost of \$181 million and to provide a credit of \$84 million. RDC agreed to repay CMCC through the export of blister copper. After electrorefining the copper in China, CMCC agreed to return the recovered gold and silver to RDC. A formal contract will be negotiated and is expected to be ratified in 1989.

Iron and Steel.—The Bin Qasim steelworks of Pakistan Steel Mills Corp. Ltd. (PSM) was the country's only integrated iron and steel complex, which reached its rated output of 1.1 million tons per year in 1987.

Karachi Rolling Mills Ltd., News-hera Engineering Co. Ltd., and Special Steels of Pakistan Ltd. collectively provided steel output of 100,000 tons. A few small steel mills contributed about 40,000 tons of steel production capacity. The smaller, nonintegrated mills generally utilized scrap metal. About 75% of the ship plate generated by Pakistan's shipbreaking industry went directly for rerolling, and the remainder went for remelting.

Other.—In addition to the gold and silver in Saindak copper deposit, there

was associated magnetite, molybdenite, and pyrite that could be recovered for local treatment or for export. Frontier and Tribal Areas Development Corp. (FTAD) drilled around Shinkai, Waziristan, to evaluate copper deposits. Pakistan Mineral Development Corp. (PMDC) evaluated gold occurrences in north Pakistan and in Chagai. PMDC's objective was to locate the source rock of the gold particles found in the tributaries of the Indus River. Another objective was to evaluate the iron ore deposits at Nokkundi around Chagai for gold content. FTAD was investigating manganese in north Waziristan and chromite in Bajaur.

Industrial Minerals.—There is mine production of a wide array of industrial minerals in Pakistan. However, the large activities are quarrying operations for low-unit-value material—sand and gravel and stone. About 1 million tons of various grades and types of clays was produced. The only other minerals produced in locally significant quantities were salt, both rock and marine, and gypsum. The remainder of the industrial minerals domestically produced were negligible in terms of world output. The largest manufacturing sectors were cement and fertilizers.

Cement.—There were eight private-sector cement producers, each with a single plant. They collectively constituted an annual kiln output capacity of 2.3 million tons. In addition, the State Cement Corp. of Pakistan (Pvt.) Ltd. had 13 companies operating 15 plants with a total annual kiln capacity of 5.24 million tons. Altogether, Pakistan's aggregate kiln capacity was 7.56 million tons. In 1988, the total production of cement was 7.3 million tons. This estimate was based on 8 private companies and 10 state companies operating 11 plants, collectively producing at 96.5% of rated capacity.

Fertilizer Materials.—Because Pakistan has an agrarian-based economy, the chemical fertilizer sector is one of

TABLE 7
PAKISTAN: PRODUCTION OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1984	1985	1986	1987	1988 ^p
METALS					
Aluminum: Bauxite, gross weight	2,720	1,759	2,881	3,447	2,452
Antimony ore:					
Gross weight	6	24	—	45	*50
Sb content ^o	1	4	—	7	8
Chromium: Chromite:					
Gross weight	2,997	5,188	8,299	10,181	3,327
Cr content ^o	989	1,712	2,739	3,330	1,090
Iron and steel:					
Pig iron thousand tons	*566	803	892	*1,200	*1,200
Steel, crude ^o do.	610	700	800	1,100	1,100
Lead, refined, secondary ^o	1,000	1,000	1,000	2,000	2,000
Manganese ore:					
Gross weight	8	135	635	30	—
Mn content ^o	2	41	190	9	—
INDUSTRIAL MINERALS					
Abrasives, natural: Emery	1,393	4,630	4,972	*3,500	*3,500
Barite	27,230	29,932	39,047	10,031	22,198
Cement, hydraulic thousand tons	4,697	*5,229	*6,130	6,832	*7,300
Chalk	1,360	2,082	2,192	4,292	5,035
Clays:					
Bentonite	1,740	1,611	1,282	2,537	4,880
Fire clay	79,528	68,537	87,522	122,513	124,581
Fuller's earth	19,139	10,647	15,228	17,945	12,395
Kaolin (china clay)	11,711	6,644	37,056	32,208	41,968
Other	130,000	285,000	520,000	680,661	924,237
Feldspar	5,486	5,633	11,575	6,675	9,026
Fluorspar	2,724	3,175	4,353	3,528	284
Gypsum, crude	375,000	409,000	373,000	449,013	374,258
Magnesite, crude	4,153	2,113	1,757	3,824	3,081
Nitrogen: N content of ammonia	1,127,700	1,106,800	1,154,400	1,179,000	*1,200,000
Phosphate rock: ^o					
Gross weight	—	—	50,000	32,000	35,000
P ₂ O ₅	—	—	16,000	10,000	11,000
Pigments, mineral, natural: Ocher	1,046	553	608	1,792	1,040
Salt:					
Rock thousand tons	598	583	576	268	406
Marine do.	*180	269	242	14	*250
Total do.	*778	852	818	282	656
Sand and gravel:					
Gravel	74,000	16,000	—	10,750	—

See footnotes at end of table.

TABLE 7—Continued
PAKISTAN: PRODUCTION OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1984	1985	1986	1987	1988 ^p
INDUSTRIAL MINERALS—Continued					
Sand and gravel—Continued					
Sand:					
Bajri and common	294,397	352,496	136,964	208,339	*210,000
Glass	100,000	202,000	115,000	148,783	133,991
Sodium compounds, n.e.s.:					
Caustic soda	*40,600	*52,300	*54,000	56,571	*62,000
Soda ash, manufactured	*121,000	118,087	130,894	133,133	*140,000
Stone:					
Aragonite and marble	80,000	62,000	168,000	228,619	211,896
Dolomite	121,750	121,578	136,271	141,846	69,131
Limestone thousand tons	5,184	6,685	6,339	7,278	6,428
Other (reported as "ordinary stone") do.	525	366	677	551	*580
Strontium minerals: Celestite	564	718	997	1,114	488
Sulfur:					
Native	926	877	890	*1,120	690
Byproduct, all sources ^e	26,000	26,000	26,000	26,000	26,000
Total^a	26,926	26,877	26,890	27,120	26,690
Talc and related materials: Soapstone	15,568	20,183	23,021	23,278	37,429
MINERAL FUELS AND RELATED MATERIALS					
Coal, all grades thousand tons	2,134	2,199	2,025	2,419	3,199
Coke do.	*533	556	630	526	*600
Gas, natural:					
Gross production million cubic feet	352,933	366,282	392,485	410,849	*445,000
Marketed production (sales) ^e do.	331,108	345,000	370,000	388,000	420,000
Natural gas liquids ^e thousand 42-gallon barrels	45	55	65	70	75
Petroleum:					
Crude do.	6,534	12,522	15,065	15,230	*16,700
Refinery products:					
Gasoline do.	5,457	5,738	5,865	7,012	*7,000
Jet fuel do.	3,792	3,712	3,944	*3,712	*3,700
Kerosene do.	2,000	2,379	3,209	*3,015	*3,000
Distillate fuel oil do.	10,004	11,473	13,152	13,040	*13,000
Residual fuel oil do.	10,216	10,250	11,382	11,635	*12,000
Lubricants do.	742	875	980	*1,005	*1,000
Other do.	2,592	3,217	3,526	*3,615	*4,000
Total do.	34,803	37,644	42,058	43,034	*43,700

^a Estimated. ^p Preliminary. ^r Revised.

¹ Table includes data available through July 31, 1989.

TABLE 8
PAKISTAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987		
			United States	Other (principal)	
METALS					
Aluminum: Metal including alloys:					
Scrap	15	—	—		
Unwrought	—	2	—	All to Yugoslavia.	
Chromium: Ore and concentrate	31,223	6,772	—	All to Sweden.	
Copper: Metal including alloys, scrap	810	605	—	Japan 356; Republic of Korea 93.	
Iron and steel: Metal:					
Scrap	value, thousands	\$691	\$715	—	Japan \$487; India \$121; Republic of Korea \$64.
Pig iron, cast iron, related materials	133,444	113,153	—	China 52,500; Bulgaria 28,622, Bangladesh 21,500.	
Steel, primary forms	59,504	25,340	10,005	West Germany 9,796; Japan 5,539.	
Semimanufactures:					
Bars, rods, angles, shapes, sections	818	8	—	Bangladesh 7.	
Universals, plates, sheets	230	205	—	Sri Lanka 100; Austria 40.	
Wire	134	213	—	West Germany 167; Bangladesh 28.	
Tubes, pipes, fittings	714	300	—	Afghanistan 274.	
Castings and forgings, rough	4	—	—		
Lead: Oxides	—	5	—	All to Bangladesh.	
Mercury	76-pound flasks	—	29	—	All to Hong Kong.
Nickel: Metal including alloys, scrap	4	52	—	All to United Kingdom.	
Silver: Ore and concentrate	value, thousands	\$2,212	\$1,180	—	Do.
Uranium and/or thorium: Ore and concentrate	do.	\$562	—		
Zinc:					
Oxides	10	—	—		
Metal including alloys, semimanufactures	—	700	—	All to United Arab Emirates.	
Other:					
Ores and concentrates	value, thousands	\$9	\$55	—	United Arab Emirates \$27.
Ashes and residues	—	20	—	All to United Arab Emirates.	
Base metals including alloys, all forms	17	—			
INDUSTRIAL MINERALS					
Abrasives, n.e.s.: Grinding and polishing wheels and stones	1	2	—	All to West Germany.	
Asbestos, crude	2	—	—		
Barite and witherite	—	5	—	All to Bangladesh.	
Cement	—	214	—	All to Maldives.	
Clays, crude	100	144	—	Bangladesh 114; China 30.	
Cryolite and chiolite	—	150	—	All to Bangladesh.	
Fertilizer materials:					
Crude, n.e.s.	213,594	198,637	—	United Arab Emirates 191,968; Qatar 5,174.	
Manufactured: Nitrogenous	173,003	—			

See footnotes at end of table.

TABLE 8—Continued
PAKISTAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Gypsum and plaster	60	—		
Mica:				
Crude including splittings and waste	10	45	—	All to Kuwait.
Worked including agglomerated splittings	—	1	—	Do.
Precious and semiprecious stones other than diamond: Natural value, thousands	\$4,839	\$6,568	\$1,157	Hong Kong \$3,300; Switzerland \$714.
Salt and brine	18,409	18,746	—	India 12,766; United Arab Emirates 791; Kenya 350.
Sodium compounds, n.e.s.: Carbonate, manufactured	—	1,056	—	Bangladesh 937; Malaysia 75.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	5,617	6,161	45	Italy 1,134; Japan 988; Singapore 668.
Worked	20	—		
Dolomite, chiefly refractory-grade	350	1,303	—	All to Bangladesh.
Gravel and crushed rock	395	1,042	—	Do.
Limestone other than dimension	—	1,002	—	Do.
Sand other than metal-bearing	3,194	—		
Sulfur:				
Elemental: Colloidal, precipitated, sublimed	1	20	—	All to Hong Kong.
Sulfuric acid	102	105	—	Afghanistan 93; India 12.
Other: Crude	20	15,000	—	All to Sweden.
MINERAL FUELS AND RELATED MATERIALS				
Carbon black	46	803	—	Sri Lanka 578; India 100; Tanzania 80.
Coke and semicoke	20,000	449	—	All to Bangladesh.
Petroleum refinery products:				
Lubricants thousand 42-gallon barrels	178	309	—	India 161; United Arab Emirates 69; Singapore 30.
Residual fuel oil do.	906	992	—	Yemen, Aden 664; United Arab Emirates 246.
Bitumen and other residues do.	120	69	—	United Arab Emirates 50; Oman 19.
Bituminous mixtures do.	36	12	—	All to United Arab Emirates.

¹ Table prepared by Audrey D. Wilkes.

TABLE 9
PAKISTAN: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	1	69	—	West Germany 43; China 11.
Aluminum:				
Ore and concentrate	—	1	—	All from Japan.
Oxides and hydroxides	3,007	2,792	101	China 1,574; West Germany 296.
Metal including alloys:				
Scrap	21,799	27,955	225	Netherlands 5,773; United Arab Emirates 4,736.
Unwrought	7,747	13,753	502	Bahrain 6,599; United Arab Emirates 3,672.
Semimanufactures	7,522	9,058	747	Switzerland 948; West Germany 944.
Beryllium: Metal including alloys, all forms	—	265	—	United Kingdom 185; Saudi Arabia 35.
Chromium:				
Ore and concentrate	15	21	—	All from Netherlands.
Oxides and hydroxides	88	112	3	China 77; U.S.S.R. 19.
Cobalt: Oxides and hydroxides	13	15	11	Netherlands 2.
Columbium and tantalum: Metal including alloys, all forms: Tantalum value, thousands	—	\$1	—	All from West Germany.
Copper:				
Matte and speiss including cement copper	9	20	—	All from China.
Metal including alloys:				
Scrap	209	232	—	Bahrain 100; United Arab Emirates 69.
Unwrought	162	194	—	West Germany 83; Japan 76.
Semimanufactures	9,984	12,628	46	Japan 5,886; Saudi Arabia 1,823.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite thousand tons	1,469	1,105	—	Australia 315; Brazil 244; Liberia 178.
Metal:				
Scrap	147,210	587,023	375,140	United Arab Emirates 60,878; United Kingdom 49,687.
Pig iron, cast iron, related materials	4,971	1,216	100	West Germany 612; Canada 397.
Ferroalloys:				
Ferromanganese	8,056	12,397	—	China 5,797; France 2,871; Switzerland 1,869.
Unspecified	54,575	13,713	—	China 3,949; Belgium-Luxembourg 3,557; Brazil 2,013.
Steel, primary forms	9,562	30,172	35	Australia 17,878; West Germany 9,543.
Semimanufactures:				
Bars, rods, angles, shapes, sections	35,106	31,741	253	Japan 20,202; West Germany 6,577.
Universals, plates, sheets	326,088	356,596	21,216	Japan 146,192; West Germany 47,322.
Hoop and strip	25,355	8,927	8	Japan 5,866; West Germany 1,638.
Rails and accessories	12	—	—	—

See footnote at end of table.

TABLE 9—Continued
PAKISTAN: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Semimanufactures—Continued				
Wire	19,419	6,871	—	Japan 3,039; China 1,452; Republic of Korea 1,446.
Tubes, pipes, fittings	81,547	63,478	3,765	Japan 31,698; Republic of Korea 12,245.
Castings and forgings, rough	1,835	774	4	United Kingdom 297; Italy 119.
Lead:				
Ore and concentrate	205	204	—	Morocco 199; Liberia 5.
Oxides	857	658	—	China 508; West Germany 69.
Metal including alloys:				
Scrap	210	37	—	All from China.
Unwrought	2,743	4,196	239	China 799; U.S.S.R. 672.
Semimanufactures	19	229	(²)	United Kingdom 201.
Magnesium: Metal including alloys, all forms	14	11	5	Italy 6.
Manganese:				
Ore and concentrate	229	27,592	—	Australia 27,572.
Oxides	1,799	2,230	9	Singapore 868; China 591.
Mercury 76-pound flasks	1,828	2,814	—	China 2,379; Mongolia 406.
Molybdenum: Metal including alloys, all forms value, thousands	\$82	\$31	—	Austria \$12; Afghanistan \$10.
Nickel:				
Matte and speiss	638	341	—	Australia 127; West Germany 80.
Metal including alloys:				
Scrap	19	—	—	—
Unwrought	246	452	3	United Kingdom 156; West Germany 131.
Semimanufactures	57	163	1	Bahrain 100; West Germany 20.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	\$3	\$7	\$7	—
Silver:				
Ore and concentrate ³ do.	\$14	—	—	—
Metal including alloys, unwrought and partly wrought do.	\$75	\$122	—	West Germany \$118.
Tin: Metal including alloys:				
Scrap	30	—	—	—
Unwrought	570	188	—	Malaysia 161; China 11.
Semimanufactures	17	75	—	Mainly from United Kingdom.
Titanium: Oxides	3,339	3,566	218	United Kingdom 1,837; West Germany 683.

See footnotes at end of table

TABLE 9—Continued
PAKISTAN: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
METALS—Continued					
Tungsten:					
Ore and concentrate		1	—		
Metal including alloys, all forms	value, thousands	\$591	\$1,045	—	Netherlands \$949; United Kingdom \$45.
Uranium and/or thorium:					
Ore and concentrate	do.	\$50	\$42	—	All from Australia.
Metal including alloys, all forms	do.	\$13	\$21	—	Hong Kong \$14; United Kingdom \$7.
Zinc:					
Oxides		294	444	—	France 168; China 146; Belgium-Luxembourg 73.
Metal including alloys:					
Scrap		—	39	—	All from Malaysia.
Unwrought		14,634	16,443	100	China 7,982; Australia 2,620.
Semimanufactures		114	14	—	United Kingdom 12.
Other:					
Ores and concentrates		424	885	5	Australia 823.
Base metals including alloys, all forms		78	102	(⁴)	Hong Kong 46; China 38.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		936	1,804	154	China 460; Netherlands 384.
Artificial: Corundum		64	192	—	France 54; Italy 54; Brazil 48.
Dust and powder of precious and semiprecious stones including diamond	value, thousands	\$8	—		
Grinding and polishing wheels and stones		783	1,220	2	China 863; West Germany 81.
Asbestos, crude		4,383	6,300	—	Canada 4,484; Singapore 1,060.
Barite and witherite		6	73	—	China 50; West Germany 23.
Boron materials:					
Crude natural borates		77	38	—	All from Turkey.
Oxides and acids		406	537	—	China 244; Italy 228.
Cement		132,326	32,894	26	United Arab Emirates 12,456; U.S.S.R. 8,000; Japan 4,883.
Chalk		7,594	5,491	—	Belgium-Luxembourg 3,269; United Kingdom 2,037.
Clays, crude		65,845	21,886	76	United Kingdom 17,386; Belgium-Luxembourg 1,588.
Cryolite and chiolite		1	5,005	—	All from Denmark.
Diamond: Industrial stones	value, thousands	—	\$3	—	All from Hong Kong.
Diatomite and other infusorial earth		143	493	409	Spain 55; West Germany 19.
Feldspar, fluorspar, related materials		207	65	—	All from France.
Fertilizer materials:					
Crude, n.e.s.		—	1,028	—	France 1,000; West Germany 28.

See footnotes at end of table.

TABLE 9—Continued
PAKISTAN: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials—Continued				
Manufactured:				
Ammonia	24	17	3	United Kingdom 9; West Germany 3.
Nitrogenous	65,481	252,320	14,700	U.S.S.R. 90,269; Kuwait 62,678.
Phosphatic	654,981	808,535	407,559	Jordan 182,315; Netherlands 62,090.
Potassic	—	5	—	All from United Kingdom.
Unspecified and mixed	26,501	83,389	—	All from Netherlands.
Graphite, natural	1,959	2,271	—	China 1,666; France 217.
Gypsum and plaster	(²)	13	3	West Germany 10.
Lime	25,013	14	—	United Kingdom 9; Indonesia 5.
Magnesium compounds: Magnesite, crude	486	1,178	16	Austria 466; China 242.
Mica:				
Crude including splittings and waste	—	2	—	All from United Kingdom.
Worked including agglomerated splittings	2	4	—	China 2; Japan 1.
Nitrates, crude	46	9	—	All from West Germany.
Phosphates, crude	147,975	193,838	—	Jordan 193,827.
Pigments, mineral: Iron oxides and hydroxides, processed	2,571	3,172	20	China 2,541; West Germany 548.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	\$162	\$670	—	Hong Kong \$353; Switzerland \$230.
Synthetic do.	\$11	\$10	—	Hong Kong \$6; France \$2.
Pyrite, unroasted	\$275	—	—	
Salt and brine	(²)	203	—	Denmark 107; West Germany 95.
Sodium compounds, n.e.s.: Carbonate, manufactured	51	50	—	Spain 25; Thailand 20.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	462	357	13	Italy 278; Greece 45.
Worked	919	8,769	—	United Kingdom 8,696; Italy 73.
Dolomite, chiefly refractory-grade	1,160	5,071	55	Italy 4,646; Spain 250.
Gravel and crushed rock	—	32	9	Hong Kong 20.
Quartz and quartzite	19	—	—	
Sand other than metal-bearing	253	117	17	China 80; United Kingdom 13.
Sulfur:				
Elemental:				
Crude including native and byproduct	27,185	34,875	—	Iran 16,016; Qatar 8,059; Bahrain 3,791.
Colloidal, precipitated, sublimed	851	606	—	China 417; Republic of Korea 82.
Sulfuric acid	13	9	—	China 6; West Germany 3.
Talc, steatite, soapstone, pyrophyllite	13,638	1,429	—	China 1,105; Republic of Korea 100.

See footnotes at end of table.

TABLE 9—Continued
PAKISTAN: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Other:				
Crude	18,830	14,255	35	China 7,477; India 5,022.
Slag and dross, not metal-bearing	44	385	—	West Germany 323; Hungary 59.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	4,514	324	261	Netherlands 30; United Kingdom 27.
Carbon black	2,132	1,380	10	China 495; Singapore 343.
Coal:				
Anthracite and bituminous	810,234	809,190	77,832	Australia 542,424; Canada 188,535.
Briquets of anthracite and bituminous coal	—	15	—	All from United Kingdom.
Lignite including briquets value, thousands	\$11	\$20	\$8	United Kingdom \$12.
Coke and semicoke	29	3	—	All from United Kingdom.
Petroleum:				
Crude thousand 42-gallon barrels	26,933	27,569	—	Saudi Arabia 14,840; Iran 7,173; United Arab Emirates 5,556.
Refinery products:				
Liquefied petroleum gas value, thousands	\$3	\$11	\$3	Japan \$6.
Gasoline thousand 42-gallon barrels	875	1,114	—	Kuwait 1,098.
Mineral jelly and wax do.	76	75	(^a)	China 43; Iraq 15.
Kerosene and jet fuel do.	4,051	5,037	—	Kuwait 5,021.
Distillate fuel oil do.	11,777	17,217	(^a)	Kuwait 17,216.
Lubricants do.	61	69	12	West Germany 20; United Kingdom 7.
Residual fuel oil do.	66	(^a)	—	Mainly from China.
Bitumen and other residues do.	(^a)	—	(^a)	United Kingdom 20.
Bituminous mixtures do.	20	26	(^a)	All from United Kingdom.
Petroleum coke do.	—	(^a)	—	

¹ Table prepared by Audrey D. Wilkes.

² Less than 1/2 unit.

³ May include platinum-group metals.

⁴ Unreported quantity valued at \$11,000.

⁵ Unreported quantity valued at \$786,000.

the country's largest manufacturing industries. National Fertilizer Corp. Ltd. is the largest producer with three plants producing urea, one plant for ammonium sulfate, two for single superphos-

phate, one for ammonium nitrate, and one for nitrophosphate. Dawood Hercules Chemicals Ltd., Exxon Chemicals (Pvt.) Ltd., and Fanji Fertilizer Co. each have a single plant for urea

production. Pakistan Steel Mills Corp. Ltd. produced ammonium sulfate as a byproduct of its steel operations. Pakistan's chemical fertilizer production is shown in the text table in metric tons.

	Urea	Ammonium nitrate	Nitro-phosphate	Ammonium sulfate	Super-phosphate
1980	640,511	199,000	137,230	98,868	101,198
1981	962,906	272,671	171,209	96,642	101,813
1982	1,223,478	321,391	210,510	94,005	102,691
1983	1,831,819	339,380	238,352	61,182	105,690
1984	1,797,553	383,011	316,450	72,985	105,801
1985	1,814,666	406,357	308,306	79,009	105,760
1986	1,820,214	394,255	321,392	92,285	107,584
1987	1,992,644	413,314	323,449	91,615	106,150
1988	2,048,000	343,656	332,502	99,305	

Mineral Fuels.—Domestic production of coal, petroleum, and natural gas accounted for about two-thirds of Pakistan's primary commercial energy requirements. The remainder was supplied by imports of coal and petroleum.⁶¹ However, production and imports of conventional fuels constituted about 60% of the country's total energy supplies, considering noncommercial fuels. The Ministry of Planning and Development estimated that up to 40% of the total energy supply was from the utilization of nonconventional energy forms such as bagasse, cotton sticks, dung cakes, fuelwood, rice husks, sawdust, and tobacco sticks. The majority of Pakistan's population, about 70%, lived in rural areas where these fuels were used in varying degrees. This estimate of vegetal fuels utilization indicated only an order of magnitude because of the difficulties in compiling, verifying, and standardizing data in nonstandard units such as bundles, baskets, bags, and headloads.

The three major Government-owned energy companies were the Oil and Gas Development Corp. (OGDC), Pakistan State Oil Co. (PSOC), and Pakistan Mineral Development Corp. (PMDC).

OGDC's activities included exploration, drilling, and production of crude oil, as well as the production and marketing of natural gas and condensate. OGDC also undertook exploration work for foreign private and public sector companies under a policy of sharing proportionate initial cost and profit in the event of commercial discovery.

OGDC was the operator of the Toot, Fimkassar, and Tando Alam Fields and was developing the Dhodak Field.

PSOC was Pakistan's largest company with sales of about \$1.2 billion. It was the country's main oil storage, distribution, and marketing company. PSOC has four storage terminals in Karachi, numerous blending plants for lubricating oil, sites for used-oil reclamation, and an 18% minority interest in Pakistan Refinery Ltd. PSOC markets liquefied petroleum gas and had a network of about 1,500 retail consumer outlets throughout the country for petroleum refinery products. PSOC had nearly two-thirds of the total market share for petroleum in Pakistan.

PMDC was originally created to undertake mineral exploration and development as an agent of the Ministry of Petroleum and Natural Resources. However, its influence in the energy sector was limited only to the coal produced by the public sector.

In 1988, 13 companies drilled 32 development wells and 24 exploration wells for oil and natural gas, totaling 125,665 meters. Twelve of these were abandoned as dry wells. At yearend, 10 wells were in the process of being drilled. In 1988, coal output increased 32% to 3.2 million tons, petroleum production increased 10% to 16.7 million barrels, and natural gas increased 8% to 445 billion cubic feet.

Coal.—Pakistan's coal resources were estimated at 800 million tons, of which

85 million has been reported by PMDC as measured reserves. Most of the measured reserves occur in the Lakhra coalfield in Sind Province. The other important coal-bearing regions include the Salt Range south of Islamabad, the area around Quetta in Baluchistan, and the Thatta District in southeast Pakistan.

The coal is generally of poor quality and is high in sulfur content. The caloric content ranges from high-volatile bituminous to subbituminous coal. Historically, mine production has been small because most of the mining has been from outcroppings of coal seams. About 53% of the mine output was in Baluchistan, 25% in Sind, 20% in Punjab, and only a little more than 1% in the Northwest Frontier Province. Private sector coal operations accounted for about 80% of the total coal production, while the public sector accounted for the remainder.

Coal accounted for about 8% of the country's total primary commercial energy requirements and for 10% of the total final commercial consumption. The brick industry, which utilizes coal-fired kilns, accounted for around 97% of the demand for domestically produced coal. The remainder is consumed by two coal-fired powerplant units at Quetta and by the residential sector for heating. Coal for heating use, however, declined because natural gas gained a larger share in the residential sector. Pakistan imported both anthracite and bituminous coal from Australia, Canada, and the United States, in order of value.

The Government continued to give priority for developing the country's coal resources as part of a national policy to reduce reliance on imported fuels. However, Pakistan Steel Mills Corp. Ltd. imports all of its requirements for metallurgical-grade coal for its operations. In 1988, the Geological Survey of Pakistan revised its estimate for the country's coal resources to be possibly as much as 7 billion tons. Punjab Mineral Development Corp. earmarked \$1.5 million for coal explo-

ration in Punjab Province. Seventy-eight boreholes totaling 12,120 meters were drilled in the Salt Range, yielding good quality coal deposits with a proven reserve of 15 million tons.

Mine output at Padhrar expanded from 25,000 tons per year to 60,000 tons per year. In addition, expansion of the output of the coal mines at Dandot to 15,000 tons per year was undertaken with financial assistance from the United Nations Development Program. FTA conducted exploration and evaluation of coal deposits in the Aurakzai Agency of the tribal area.

The Government embarked on a program to increase the coal share in the country's total primary commercial energy requirements. Under the expansion program, proposals for coal-fired powerplants were one 500-MW unit at Lakhra, one 100-MW unit at Lakhra (fluidized bed combustion), one 80-MW unit at Punjab (fluidized bed combustion), three 55-MW units at Chakwal (fluidized-bed combustion), and two 15-MW units at Quetta.

Natural Gas.—Natural gas accounted for about 35% of the country's total primary commercial energy requirements. Aside from hydropower electric generation, natural gas was Pakistan's major electricity generating fuel and provided about one-third of the country's total final energy consumption. Overall, natural gas was Pakistan's major fuel source because it accounted for 50% of the energy consumed by the industrial sector and 35% of the energy consumed by the residential sector. All gas consumed in Pakistan was domestically produced.

Proven reserves of natural gas were estimated to be 22.1 trillion cubic feet. The largest gasfields in the country were Sui and Mari in the center of Pakistan near the city of Jacobabad. They have proven reserves of 6.0 trillion cubic feet and 4.2 trillion cubic feet, respectively. Other gasfields in the area included Kandkhat and Pirkoh. The Dhodak and Rodho Gasfields each have less

than 3 trillion cubic feet of reserves and are in the Indus fold belt in southwestern Punjab to the west of Multan. Natural gas produced in association with oil included the Dhurnal, Meyal, and Toot Oilfields in the Potwar Plateau in Punjab, south of Islamabad. Natural gas was also associated with the country's major oil-producing area of Badin in southwest Pakistan.

Natural gas production in 1988 averaged 1.2 trillion cf/d. About two-thirds of the total production came from the Sai Field (990 million cf/d) and about 20% from Mari (320 million cf/d). Natural gas production from the Badin Oilfield was expected to begin in early 1989 at the rate of 39 million cf/d. The gas will be transported by a new 100-km-long pipeline to Hyderabad where it will connect with the existing, extensive trans-Pakistan pipeline network. The Government planned to utilize the low-quality gas from Nandpur Field near Kabirwala, 60 km north of Multan, in a 90- to 110-MW gas-fired combined-cycle powerplant to be built and operated by the private sector.

Petroleum.—While the first oil well was drilled in 1866 at Jundal in Punjab, Pakistan remained largely underexplored for oil. The country's proven recoverable oil reserves were estimated at 96 billion barrels. Based on recent surveys in partially explored basins, there was a potential reserve of 35 to 50 billion barrels. The Potwar Basin in the north and the Sind Basin near the coast have been only partially explored, while drilling and mapping in the Baluchistan Basin and large areas in the North have been minimal. Moreover, the Government remained optimistic about the potential of the country's 250,000-square-km Continental Shelf, which includes the extension of the Indus Basin and is not far from India's Bombay High, a prolific oilfield. Drilling by PetroCanada International Ltd. to a depth of 3,500 meters, 160 km south of Karachi, confirmed the presence of hydrocarbons. In addition, a survey of

the concession 65 km southwest of Islamabad held by Occidental Oil Co. (Occidental) indicated a large oil reservoir. Foreign companies intensified exploration activities in Pakistan. There were about 40 foreign firms in 1988 exploring and/or awaiting licenses for oil exploration.

More than 70% of Pakistan's production of crude oil came from fields operated by foreign companies. The major producing operations are the Dhurnal Field in the Potwar Basin in the North, 65 km southwest of Islamabad and operated by Occidental, and the fields in the Badin concession in the southeast operated by Union Texas Inc. Output at Dhurnal averaged 18,500 bbl/d and was expected to increase in 1989 when water injection will be introduced. Dhurnal crude was piped to Attock Refinery at Rawalpindi. In February 1988, commercial production from a fifth field at south Mazari increased output at Badin to 18,500 bbl/d. Badin crude was trucked to two refineries in Karachi, about 100 km away.

Because existing refinery capacity limits a higher level of crude oil production, Pakistan made its first export shipment of oil in December 1988. The consignment of the Badin crude went to Singapore. Exports through 1989 were expected to average 6,000 bbl/d; the expansion programs at the National and Karachi refineries were expected to be complete by yearend 1989 increasing throughput to 65,000 bbl/d.

SRI LANKA⁶²

Sri Lanka is a 65,600-square-km island off the southeastern tip of India, with a population of 17 million, and a per capita GDP of \$363 (1987).⁶³ It was a major world producer of colored gem stones and an important producer of heavy-mineral beach sands and graphite. Imported diamonds were cut and polished for the export trade. Ce-

ment, clays, feldspar, glass sand, gypsum, limestone, phosphate rock, and quartz were produced on a relatively small scale for domestic consumption. All mineral fuels, metals, and nitrogen

fertilizer were imported. Crude oil was refined at Sapugaskanda near Colombo. Overall, the mineral industry was not an important factor in the highly agricultural economy. Minerals

generally accounted for only a small proportion of exports, \$54 million in 1987. Titanium minerals, gem stones, graphite, and surplus oil refinery products accounted for most of the value.

TABLE 10
SRI LANKA: PRODUCTION OF MINERAL COMMODITIES^{1 2}
(Metric tons unless otherwise specified)

Commodity	1984	1985	1986	1987	1988 ^P
Cement, hydraulic ^e thousand tons	500	600	600	600	400
Clays:					
Ball clay	16,500	23,825	20,470	20,210	17,330
Kaolin	11,100	5,405	6,260	6,869	7,100
Brick and tile clay ^e	70,000	70,000	40,000	60,000	60,000
Clays for cement manufacture	*50,000	39,123	36,322	23,277	12,487
Feldspar, crude and ground	5,200	9,789	7,270	7,442	6,345
Gem stones, precious and semiprecious, other than diamond value, thousands	\$20,569	*\$20,000	\$23,304	\$13,196	*\$14,000
Graphite, all grades	5,623	7,413	7,453	*9,400	8,547
Iron and steel: Metal: Semimanufactures	15,990	9,310	10,872	33,508	*35,000
Mica, scrap ^e	200	200	200	200	200
Nitrogen: N content of ammonia	70,760	5,400	—	—	—
Petroleum refinery products: ^e					
Gasoline thousand 42-gallon barrels	1,100	1,100	1,100	1,100	1,100
Jet fuel do.	700	700	700	700	700
Kerosene do.	1,400	1,400	1,400	1,400	1,400
Distillate fuel oil do.	5,000	5,000	5,000	5,000	5,000
Residual fuel oil do.	4,350	4,350	4,500	4,500	4,500
Other do.	1,650	1,650	1,500	1,500	1,500
Refinery fuel and losses do.	800	800	800	800	800
Total do.	15,000	15,000	15,000	15,000	15,000
Phosphate rock	13,685	*14,000	14,977	20,600	22,595
Rare-earth metals: Monazite concentrate, gross weight ^e	³ 147	200	200	200	200
Salt	107,000	76,858	104,278	115,274	106,794
Stone:					
Limestone thousand tons	*1,000	*1,000	649	2,044	733
Quartz, massive	1,100	1,566	1,090	1,190	953
Titanium concentrate, gross weight:					
Ilmenite	102,048	114,854	129,907	128,500	74,305
Rutile	6,467	8,558	8,443	7,200	5,255
Zirconium: Zircon concentrate, gross weight	3,708	4,061	*4,000	*4,000	*4,000

^e Estimated. ^P Preliminary.

¹ Table includes data available through Aug. 18, 1989.

² In addition to the commodities listed, other crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

³ Reported figure.

TABLE 11

SRI LANKA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986		
			United States	Other (principal)	
METALS					
Aluminum: Metal including alloys, semimanufactures	38	² 29	—	Bangladesh 22.	
Copper: Metal including alloys, semimanufactures	value, thousands	\$4	\$1	—	All to Singapore.
Iron and steel:					
Iron ore and concentrate:					
Excluding roasted pyrite		1,365	—		
Pyrite, roasted	value, thousands	\$354	—		
Metal:					
Scrap		3,535	(³)		
Steel, primary forms	value, thousands	\$1	—		
Semimanufactures:					
Bars, rods, angles, shapes, sections	do.	\$6	\$12	—	Australia \$10.
Universals, plates, sheets		1	⁴ 36	—	All to India.
Rails and accessories		3,250	—		
Wire		1	1	—	All to Maldives.
Tubes, pipes, fittings		⁵ 15	2	—	Do.
Castings and forgings, rough	value, thousands	—	\$1	—	All to Singapore.
Lead: Metal including alloys:					
Unwrought		3	—		
Semimanufactures		40	—		
Silver:					
Ore and concentrate	value, thousands	—	\$5	—	All to Japan.
Waste and sweepings	do.	\$2	—		
Metal including alloys, unwrought and partly wrought	do.	\$2	—		
Other:					
Ores and concentrates		145,350	151,434	17,700	Netherlands 79,860; Japan 53,700.
Ashes and residues		90	(⁶)	—	All to Japan.
Base metals including alloys, all forms	value, thousands	\$1	—		
INDUSTRIAL MINERALS					
Abrasives, n.e.s.: Grinding and polishing wheels and stones	value, thousands	\$1	—		
Asbestos, crude		—	10	—	All to Australia.
Cement		379	285	—	Maldives 280.
Clays, crude		1	—		
Diamond:					
Gem, not set or strung	value, thousands	\$10,522	\$35,622	\$9	Belgium-Luxembourg \$26,716; Switzerland \$6,818.
Industrial stones	do.	\$867	\$1,069	—	All to Belgium-Luxembourg.

See footnotes at end of table.

TABLE 11—Continued
SRI LANKA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials:				
Crude, n.e.s.	23	124	—	Maldives 114.
Manufactured:				
Nitrogenous value, thousands	\$1	—		
Unspecified and mixed do.	\$51	\$1	—	Mainly to Saudi Arabia.
Graphite, natural	9,170	9,824	1,933	United Kingdom 2,368; Japan 1,752.
Mica:				
Crude including splittings and waste	534	—		
Worked including agglomerated splittings	18	—		
Precious and semiprecious stones other than diamond:				
Natural value, thousands	\$20,404	\$26,452	\$3,773	Japan \$14,038; Hong Kong \$2,249.
Synthetic do.	\$35	—		
Salt and brine	1,000	2,000	—	All to Saudi Arabia.
Stone, sand and gravel:				
Dimension stone: Crude and partly worked	2,167	1,755	—	Maldives 1,102; Italy 607.
Gravel and crushed rock	—	23	—	West Germany 21.
Quartz and quartzite	1,243	1,625	—	All to Japan.
Sand other than metal-bearing	1,056	1,271	—	All to Maldives.
Other:				
Crude value, thousands	—	\$1	—	Do.
Slag and dross, not metal-bearing	107	—		
MINERAL FUELS AND RELATED MATERIALS				
Coke and semicoke value, thousands	—	\$1	—	Do.
Petroleum refinery products:				
Liquefied petroleum gas do.	\$16	\$8	—	Do.
Gasoline, motor do.	\$2	\$9	—	NA.
Kerosene and jet fuel 42-gallon barrels	509,043	505,943	—	NA.
Distillate fuel oil do.	393,485	527,698	—	Maldives 46,356.
Lubricants value, thousands	\$502	\$1,099	\$2	NA.
Residual fuel oil 42-gallon barrels	2,416,288	2,972,531	—	Singapore 243,356; Malaysia 235,444; Bangladesh 120,459.

¹ Table prepared by Audrey D. Wilkes.

² Excludes unreported quantity valued at \$30,000.

³ Unreported quantity valued at \$3,061,000, of which: the Republic of Korea \$1,196,000; Thailand \$1,050,000; and Japan \$762,000.

⁴ Excludes unreported quantity valued at \$6,000.

⁵ Excludes unreported quantity valued at \$11,000.

⁶ Less than 1/2 unit.

TABLE 12
SRI LANKA: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity		1985	1986	Sources, 1986	
				United States	Other (principal)
METALS					
Alkali and alkaline-earth metals	value, thousands	\$6	\$7	\$4	Hong Kong \$2.
Aluminum:					
Ore and concentrate		18	36	—	All from China.
Oxides and hydroxides		636	1,516	2	United Kingdom 721; Japan 419.
Metal including alloys, all forms		3,597	5,386	81	India 759; Republic of South Africa 728; Malaysia 577.
Chromium: Oxides and hydroxides		4	(⁹)	—	All from West Germany.
Cobalt: Oxides and hydroxides	value, thousands	—	\$120	—	All from Canada.
Columbium and tantalum: Ore and concentrate		1	—		
Copper: Metal including alloys, all forms		2,196	2,919	(⁹)	United Kingdom 1,009; Japan 1,005.
Iron and steel:					
Iron ore and concentrate excluding roasted pyrite		88	(⁴)	—	
Metal:					
Scrap		(⁹)	1,268	—	United Arab Emirates 20; unspecified 1,220.
Pig iron, cast iron, related materials		134	286	10	Australia 80; Singapore 56; Republic of South Africa 36.
Ferroalloys:					
Ferromanganese		108	6	—	India 4.
Unspecified		108	38	—	Sweden 20; Norway 6.
Steel, primary forms		8,092	20,336	3	Spain 9,916; Republic of South Africa 5,089.
Semimanufactures:					
Bars, rods, angles, shapes, sections		155,803	155,603	157	Zimbabwe 103,202; Republic of South Africa 16,728.
Universals, plates, sheets		36,073	43,296	149	Japan 17,096; Republic of South Africa 13,714.
Hoop and strip		1,264	2,094	—	India 648; Japan 389; West Germany 244.
Rails and accessories		84	5,498	—	Japan 5,483.
Wire		63,276	10,273	(⁹)	Republic of South Africa 5,145; Republic of Korea 3,611.
Tubes, pipes, fittings		7,3102	7,516	7	Republic of South Africa 2,355; Thailand 1,387.
Castings and forgings, rough		16	7	—	Mainly from United Kingdom.
Lead:					
Oxides		19	15	—	United Kingdom 10; China 5.
Metal including alloys, all forms		1,987	851	17	Australia 629.
Magnesium: Metal including alloys, all forms	value, thousands	\$6	—		

See footnotes at end of table.

TABLE 12—Continued
SRI LANKA: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS—Continued				
Manganese:				
Ore and concentrate	290	104	—	All from Singapore.
Oxides	1,044	1,685	—	Singapore 924; Belgium-Luxembourg 390.
Mercury 76-pound flasks	29	29	—	NA.
Molybdenum: Metal including alloys, all forms value, thousands	\$4	\$8	—	Japan \$6.
Nickel:				
Matte and speiss	—	\$2	\$2	
Metal including alloys, all forms	9	6	(^c)	Switzerland 4.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	\$4	—		
Silver: Metal including alloys, unwrought and partly wrought do.	\$16	\$19	\$1	West Germany \$12; Switzerland \$4.
Tin:				
Ore and concentrate	88	1	—	All from Japan.
Metal including alloys:				
Scrap	46	(^b)		
Unwrought	4	18	—	United Kingdom 12.
Semimanufactures	26,229	7	—	India 6.
Titanium: Oxides	151	163	—	United Kingdom 48; Belgium-Luxembourg 35.
Tungsten:				
Ore and concentrate value, thousands	—	\$2	—	All from United Kingdom.
Metal including alloys, all forms do.	\$151	\$104	\$6	Belgium-Luxembourg \$52; Sweden \$34.
Uranium and/or thorium: Metal including alloys, all forms do.	\$6	—		
Zinc:				
Ore and concentrate	2	1	—	India (^b); United Kingdom (^b).
Oxides	731	779	—	China 349; Republic of Korea 181.
Metal including alloys:				
Scrap	—	12	—	Belgium-Luxembourg 10.
Unwrought	1,031	1,524	126	Canada 827; Australia 551.
Semimanufactures	153	36	—	Canada 17; Singapore 6.
Other:				
Ores and concentrates	142	71	—	Japan 53; Italy 18.
Ashes and residues	9	—		
Base metals including alloys, all forms	15	16	—	China 15.

See footnotes at end of table.

TABLE 12—Continued
SRI LANKA: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	158	72	—	Hong Kong 40; India 25.
Artificial: Corundum	2	22	—	Japan 11; Italy 9.
Dust and powder of precious and semiprecious stones including diamond value, thousands	\$317	\$178	\$23	Belgium-Luxembourg \$95; United Kingdom \$60.
Grinding and polishing wheels and stones	63	137	(⁶)	China 50; India 21; United Kingdom 16.
Asbestos, crude	8,590	5,586	—	China 4,350; Zimbabwe 1,225.
Berite and witherite	15	134	—	India 74; United Kingdom 40.
Boron materials: Oxides and acids	61	36	9	China 12; India 12.
Cement	319,775	400,784	4	Indonesia 193,246; Japan 82,165; Kenya 60,203.
Chalk	73	252	—	United Kingdom 158; Australia 41.
Clays, crude	6,403	9,720	7	Republic of Korea 8,000; United Kingdom 825.
Diamond:				
Gem, not set or strung value, thousands	\$16,310	\$28,639	\$3	Ghana \$13,548; China \$8,930.
Industrial stones do.	\$69	\$460	—	Ghana \$431.
Diatomite and other infusorial earth	15	83	47	China 20; West Germany 10.
Feldspar, fluor spar, related materials	—	3	—	All from Italy.
Fertilizer materials:				
Crude, n.e.s. value, thousands	\$97	\$3	—	Philippines \$2.
Manufactured:				
Ammonia	113	99	—	United Kingdom 42; Netherlands 25.
Nitrogenous	236,399	(⁶)	—	Iraq 19,105; China 5,000; Jordan 3,300.
Phosphatic	33,087	31,242	—	Singapore 25,155; U.S.S.R. 13,210; Canada 10,250.
Potassic	91,714	60,308	—	Japan 8,620; Republic of Korea 8,254; Republic of South Africa 3,606.
Unspecified and mixed	12,502	20,581	—	Thailand 5,165; India 3,219; Japan 3,092.
Gypsum and plaster	15,107	12,445	—	India 50.
Lime	1,150	57	—	Japan 10; China 5.
Magnesium compounds: Magnesite, crude including calcined	214	19	—	United Kingdom 5.
Mica: Crude including splittings and waste	133	7	—	All from West Germany.
Nitrates, crude	—	15	—	Egypt 7,608; Israel 2,751; West Germany 2,000.
Phosphates, crude	24,025	13,434	—	West Germany 308; India 142.
Pigments, mineral: Iron oxides and hydroxides, processed	952	618	—	Potassium salts, crude
Potassium salts, crude	1	—	—	

See footnotes at end of table

TABLE 12—Continued
SRI LANKA: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Precious and semiprecious stones other than diamond:				
Natural value, thousands	\$226	\$130	\$47	Hong Kong \$41; Canada \$29.
Synthetic do.	\$20	\$25	\$2	Hong Kong \$14.
Salt and brine	260	216	—	United Kingdom 171.
Sodium compounds, n.e.s.: Carbonate, manufactured	3,243	5,488	—	Kenya 1,855; West Germany 1,115; Belgium-Luxembourg 1,058.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	174	42	—	Italy 19; Japan 7.
Worked value, thousands	\$150	\$503	—	Belgium-Luxembourg \$386; Italy \$60; Japan \$41.
Dolomite, chiefly refractory-grade	18	11	—	Norway 8.
Gravel and crushed rock	1,148	1,376	(⁹)	India 1,211.
Limestone other than dimension	74	—	—	—
Quartz and quartzite	(¹⁰)	7	—	All from Belgium-Luxembourg.
Sand other than metal-bearing	425	38	—	Japan 19; United Kingdom 11.
Sulfur:				
Elemental:				
Crude including native and byproduct	336	363	—	Republic of Korea 262; Belgium-Luxembourg 39.
Colloidal, precipitated, sublimed	309	280	—	Republic of Korea 157; Singapore 100.
Sulfuric acid	613	683	—	Singapore 610.
Talc, steatite, soapstone, pyrophyllite	1,789	1,381	2	China 703; India 605.
Other:				
Crude	1,813	1,144	—	West Germany 1,100.
Slag and dross, not metal-bearing	—	186	—	Singapore 165.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	1,557	165	4	Singapore 150.
Carbon black	3,179	18,261	120	Switzerland 14,107; Republic of Korea 1,731.
Coal, all grades including briquets value, thousands	\$411	\$1,420	\$1	Australia \$615; Republic of South Africa \$606.
Coke and semicoke	1,670	1,334	—	Belgium-Luxembourg 426; Australia 314; Singapore 120.
Petroleum:				
Crude thousand 42-gallon barrels	12,392	12,283	—	United Arab Emirates 7,231; Iran 1,838; Malaysia 1,825.
Refinery products:				
Liquefied petroleum gas value, thousands	\$549	\$1	—	All from Japan.
Gasoline 42-gallon barrels	4,718	4,352	765	Australia 2,737; Singapore 527.

See footnotes at end of table.

TABLE 12—Continued
SRI LANKA: IMPORTS OF MINERAL COMMODITIES¹
(Metric tons unless otherwise specified)

Commodity		1985	1986	United States	Sources, 1986
					Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Mineral jelly and wax	42-gallon barrels	12,576	14,158	—	China 917; Japan 625; West Germany 101.
Kerosene and jet fuel	value, thousands	\$12,112	\$15,589	\$28	China \$7,851; Singapore \$3,890.
Distillate fuel oil	do.	\$24,554	\$21,463	—	Singapore \$15,612; Saudi Arabia \$3,434.
Lubricants	42-gallon barrels	12,383	12,306	378	Singapore 6,776; Republic of Korea 1,848; Netherlands 1,435.
Residual fuel oil	value, thousands	\$1	\$1	—	All from Japan.
Bitumen and other residues	42-gallon barrels	4,581	25,785	12	Pakistan 23,089.
Bituminous mixtures	do.	11,187	30,585	—	Singapore 30,391.

¹ Table prepared by Audrey D. Wilkes.

² Unreported quantity valued at \$1,000.

³ Unreported quantity valued at \$5,000.

⁴ Unreported quantity valued at \$11,000.

⁵ Unreported quantity valued at \$6,000.

⁶ Less than 1/2 unit.

⁷ Excludes unreported quantity valued at \$2,423,000.

⁸ Unreported quantity valued at \$28,000.

⁹ Unreported quantity valued at \$23,893,000 of which the U.S.S.R. was the principal source.

¹⁰ Unreported quantity valued at \$18,000.

The economy has suffered setbacks during the last few years because of serious civil strife. The GDP was projected at \$6.2 billion for 1988 with a real growth rate of 3%. The budget deficit was estimated at \$1.3 billion and the Government struggled to reduce an inflation rate of 15%. Defense, Government wages, and drought relief were some factors which led to increased spending. Overall foreign debt was \$5 billion, 85% of which was in low interest long term concessionary loans. The debt service ratio was 27%.

After being suspended because of an environmental protest petition in August 1987, strip mining for gem stones was allowed to resume in the Kalu Gunga area near Elehara in Matale District by Ceylon Sapphires (Pvt.) Ltd. The situation was resolved after an in-depth review by a Government-appointed panel of experts by imposing

a few adjustments to the strip mining operation to minimize environmental damage. Ceylon Sapphire and another company, P.N.P. Joint Ventures (Pvt.) Ltd. were expected to conduct mechanized strip mining on the 1,200-hectare lease site.⁶⁴

Gem stones occur in several areas along lower Quaternary age alluvium and river gravel, mainly in Patnapura District. The main gem stones obtained were aquamarine, beryl, crysoberyl, garnet, moonstone, ruby, sapphire, spinel, topaz, tourmaline, and zircon. A rich deposit of topaz recently found at Polwatta in central Sri Lanka was reportedly now being worked by the State Gem Corp., which has proposed a topaz marketing center to supply lapidaries with rough topaz from the deposit. State Gem has already set up lapidaries at Ratnapura and Matale. Privately owned Blue Peacock Lapidary on the west coast

specializes in diamonds and reportedly employs nearly 1,000 workers.

The Ceylon Mineral Sands Corp. reportedly was seeking tenders from mineral processing companies for synthetic rutile technology. The company would like to earn increased foreign exchange from the Pulmoddai operation by producing synthetic rutile. The much lower valued ilmenite concentrate was exported. Relatively high grade mineral sands occur intermittently along 70 km of the coastline, mostly north of Pulmoddai.

The zircon recovery plant at Pulmoddai was temporarily closed following a guerrilla attack that destroyed the water supply line to the plant.

¹ By David Yen, computer analyst, Division of International Minerals.

² Afghanistan in Mining Annual Review (London). July 1989, p. A98.

³ By Gordon L. Kinney, physical scientist, Division of International Minerals.

⁴ Where necessary, values have been converted from Bangladesh taka (T) to U.S. dollars at the rate of T31.92 = US\$1.00.

⁵ Chemical Industry News (New Delhi). V. 33, No. 11, Mar. 1989, p. 863.

⁶ The Bangladesh fiscal year begins July 1 of the year stated.

⁷ Nitrogen. No. 175, Sept.-Oct. 1988, p. 11.

⁸ Australian Journal of Mining. V. 3, No. 24, Sept. 1988, p. 75.

⁹ Indian Mining and Engineering Journal. V. 27, No. 10, Oct. 1988, p. 74.

¹⁰ By David B. Doan, physical scientist, Division of International Minerals.

¹¹ India's fiscal year begins on Apr. 1 of the year stated.

¹² Where necessary, values have been converted from Indian rupees (Rs) to U.S. dollars at the rate of Rs15.04 = US\$1.00, the rate reported as of Dec. 1, 1988.

¹³ U.S. Embassy, New Delhi, India. State Dep. Telegram 15076, June 28, 1989, p. 1.

¹⁴ Work cited in footnote 13.

¹⁵ Government of India, Department of Atomic Energy. Annual Report 1988-89, pp. 1.1-2.6.

¹⁶ U.S. Embassy, New Delhi, India. State Dep. Telegram 22272, Sept. 6, 1988, p. 6; and Metal Bulletin No. 7349, Jan. 9, 1989, p. 9.

¹⁷ Engineering and Mining Journal. V. 189, No. 10, Nov. 1988, p. 75.

¹⁸ Roskill Information Services Ltd. Economics of Cobalt, 6th ed., 1989. London, Feb. 1989, p. 46.

¹⁹ Metal Bulletin. No. 7298, July 4, 1988, p. 15, and No. 7305, July 28, 1988, p. 6.

²⁰ Mining Journal (London). V. 312, No. 8024, June 16, 1989, p. 479.

²¹ U.S. Embassy, New Delhi, India. Various State Dep. Telegrams from May 1988 and May 1989.

²² ———. State Dep. Telegrams 16451, June 30, 1988, p. 4, and 03825, Feb. 16, 1989, p. 5.

²³ U.S. Consulate, Madras, India. State Dep. Tele-

gram 2181, July 27, 1989, pp. 1-2.

²⁴ Steel Times International. V. 12, No. 4, Sept. 1988.

²⁵ Engineering and Mining Journal. V. 189, No. 9, Sept. 1988, p. 177; and U. S. Embassy, New Delhi, India. State Dep. Telegram 24051, Sept. 23, 1988, p. 1.

²⁶ U.S. Embassy, New Delhi, India. State Dep. Telegram 25667, Oct. 13, 1988, p. 5.

²⁷ Metal Bulletin. No. 7375, Apr. 13, 1989, p. 9.

²⁸ U.S. Embassy, New Delhi, India. State Dep. Telegrams 22272, Sept. 6, 1988, p. 4; and 03825, Feb. 16, 1989, p. 6.

²⁹ British Broadcasting Company, Summary of World Broadcasts, Far East, Oct. 19, 1988, p. 3.

³⁰ The Economic Times (New Delhi). Data-Bank 1989, pp. 45-49.

³¹ Phosphorus & Potassium. No. 156, July-Aug. 1988, p. 19; No. 161, May-June 1989, p. 11; and Nitrogen No. 174, July-Aug. 1988, p. 19.

³² Mining Journal (London). V. 312, No. 8011, 1989, p. 301.

³³ Indian Mining and Engineering Journal. V. 27, No. 5, May 1988, p. 33.

³⁴ Barot, N. A. The 1988 World Mining Report. International Colored Stone Association, 1989.

³⁵ U.S. Embassy, New Delhi, India. State Dep. Telegram 31160, Dec. 20, 1988, p. 7.

³⁶ Mining Magazine. V. 160, No. 3, Mar. 1989, p. 45.

³⁷ U.S. Embassy, New Delhi, India. State Dep. Telegram 31160, Dec. 20, 1988, p. 5.

³⁸ ———. State Dep. Telegram 22272, Sept. 6, 1988, p. 5.

³⁹ Indian Mining and Engineering Journal. V. 27, No. 8, Aug. 1988.

⁴⁰ U.S. Consulate, Calcutta, India. State Dep. Telegram 02574, Sept. 15, 1988, p. 1.

⁴¹ Industrial Minerals (London). No. 259, Apr. 1989.

⁴² Oil & Gas Journal. V. 86, No. 48, Nov. 28, 1988, p. 31.

⁴³ U.S. Embassy, New Delhi, India. State Dep. Telegram 01577, Jan. 20, 1989, pp. 1-2.

⁴⁴ Government of India, Ministry of Energy, Department of Coal. Report 1988-89, pp. 5-12.

⁴⁵ Page 33 of work cited in footnote 44.

⁴⁶ Page 69 of work cited in footnote 44.

⁴⁷ Gorst, Isabel. Expanding Oil Exploration. Petroleum Economist. V. 55, No. 12, Dec. 1988, p. 401.

⁴⁸ U.S. Embassy, New Delhi, India. State Dep. Telegrams 19690, 21418, and 22280, Aug. 8, 26, and Sept. 6, 1988, respectively; U. S. Consulate, Madras, India. State Dep. Telegrams 02531 and 02774, Sept. 8 and 26, 1988; U.S. Consulate, Bombay, India. State Dep. Telegrams 04312 and 00274, Sept. 13, 1988, and Jan. 20, 1989; and U.S. Consulate, Calcutta, India. State Dep. Telegram 02834, Oct. 12, 1988; all p. 1.

⁴⁹ World Oil. V. 209, No. 2, Aug. 1989, p. 118.

⁵⁰ Petroleum News. V. 19, No. 12, Mar. 1989, p. 38.

⁵¹ By Gordon L. Kinney, physical scientist, Division of International Minerals.

⁵² Where necessary, values have been converted from Nepal Rupees NR to U.S. dollars at the rate of NR23.5 = US\$1.00.

⁵³ The Rising Nepal, (Kathmandu). V. 24, No. 64, Feb. 16, 1989, p. 6.

⁵⁴ The Nepalese fiscal year runs from mid-July to mid-July.

⁵⁵ The Rising Nepal, (Kathmandu). V. 24, No. 96, Mar. 20, 1989, p. 6.

⁵⁶ ———. V. 24, No. 133, Apr. 27, 1989, p. 5.

⁵⁷ Engineering and Mining Journal. V. 189, No. 9, Sept. 1989, p. 177.

⁵⁸ By David Yen, computer analyst, Division of International Minerals.

⁵⁹ Where necessary, values have been converted from Pakistan rupees (PRs) to U.S. dollars at the rate of PRs17.399 = US\$1.00 in 1987 and PRs17.737 = US\$1.00 in 1988.

⁶⁰ Bilgrami, S.A. Mining Annual Review. Pakistan. Min. J. (London), June 1989, p. A99.

⁶¹ U.S. Embassy, Islamabad, Pakistan. State Dep. Telegram 07328, P031919Z, Feb. 24, 1989.

⁶² By Gordon L. Kinney, physical scientist, Division of International Minerals.

⁶³ Where necessary, values have been converted from Sri Lankan rupees (Rs) to U.S. dollars at the rate of Rs31.9 = US\$1.00.

⁶⁴ Mining Magazine, (London). V. 159, No. 2, Aug. 1988, p. 87.